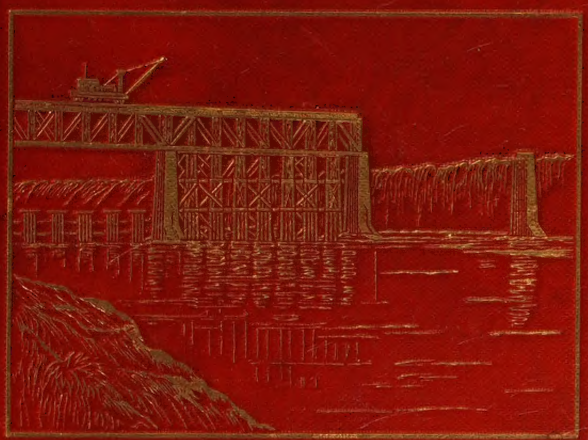
THE MAKING OF A GREAT CANADIAN RAILWAY

F. A. TALBOT



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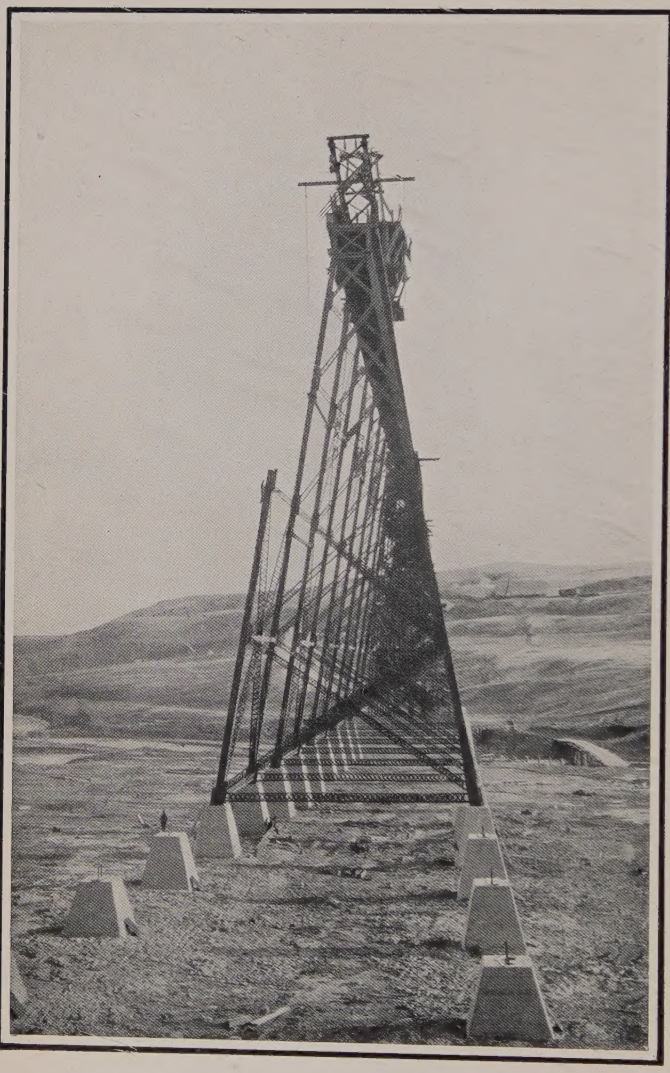

BUILDING THE BATTLE RIVER VIADUCT

This is the largest metallic structure between Winnipeg and the Pacific, being 1¾ miles long by 180 feet high in the centre. It crosses the river and the valley of the same name. The overhead traveller is seen setting one of the "bents" or tower-pieces in position.

The Making of a Great Canadian Railway

THE STORY OF THE SEARCH FOR AND DISCOVERY OF THE ROUTE, AND THE CONSTRUCTION OF THE NEARLY COMPLETED

GRAND TRUNK PACIFIC RAILWAY

FROM THE ATLANTIC TO THE PACIFIC WITH SOME ACCOUNT OF THE HARDSHIPS AND STIRRING ADVENTURES OF ITS CONSTRUCTORS IN UNEXPLORED COUNTRY

BY

FREDERICK A. TALBOT

AUTHOR OF "THE NEW GARDEN OF CANADA," &c., &c.

WITH FORTY-THREE ILLUSTRATIONS & A MAP

LONDON

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1912

PREFACE

THIS is the day of great railway-building achievements, and among these the Grand Trunk Pacific, stretching across the breadth of Canada, stands pre-eminent. Only scanty information has been communicated to the world at large concerning its inception and construction, as those participating in its realisation are busily occupied on the task.

This volume is intended to give "a peep behind the scenes" of this railway in the moulding stage. The greater part of the year 1910 I spent on the spot, fraternising with the engineers, teamsters, graders, and others engaged upon the work. I travelled from point to point by whatever vehicle was available, from pack-horse to a Pullman express, from canoe to river steamer, from team waggon to construction locomotive. When all other means of transportation failed I walked. In this way I covered not only the ground where work is completed and in active progress, but pushed across the gap of 840 miles then remaining to be built through the Rocky Mountains, and the North-western wilderness, by the only means possible—pack-horse and canoe.

This book makes no pretence to appeal to the engineer, who is concerned essentially with the purely technical side of the work. It is intended for those who are interested in the romantic side of railway-building, or who have

interests at stake in this highway. At the same time the professional mind may find something worthy of his notice; also it may serve to introduce the young engineer, waiting to win his spurs, to the conditions surrounding the laying of the steel highway in the Dominion.

My thanks are due to President Hays and the various members of his staff who spared no effort to give me every assistance; to the Commissioners of the National Trans-Continental Railway in regard to the Government section of the line; to Mr. B. B. Kelliher, the engineer-in-chief of the Grand Trunk Pacific, more especially for permission to reproduce the condensed profile of the grade between Winnipeg and Prince Rupert; to Mr. J. W. Stewart, of Messrs. Foley, Welch, and Stewart, the constructional engineers, and the numerous sub-contractors. Last, but not least, I am indebted to many whom I met for permission to reproduce the accompanying illustrations.

FREDERICK A. TALBOT.

HOVE, *July* 31*st*, 1911.

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THE MAKING OF A GREAT CANADIAN RAILWAY

CHAPTER I

THE BIRTH OF THE GRAND TRUNK PACIFIC RAILWAY

THE dawn of the twentieth century saw the Dominion of Canada on the crest of a huge wave of prosperity. The north-west was in the grip of a boom, for the potentialities of the great prairies, stretching away in an almost unbroken expanse from the eastern borders of Manitoba to the Rocky Mountains, had become realised with a suddenness which was startling. Armies of settlers from the United States and Europe were pouring into, and running over, the country west of Winnipeg in all directions, attracted by the irresistible magnet—wheat. Probably no country in the world's history has ever swept forward with such a rush as British North America, and as the time slipped by, instead of the wave diminishing, it increased in volume, and gave every indication of being permanent so long as there was any land left to be brought under the plough.

But the new arrivals were handicapped very heavily, as they found to their cost. They could till the land, and could raise their grain produce in plenty, but unless they hugged the southern stretches of the country they could not forward the prizes they wrested from the land to market. There was only one railway through the country

to handle their goods, and consequently they were in the hands of a monopoly, which, like all undisputed masters of a situation, wielded its power in an autocratic manner.

Then suddenly a new personality loomed on the transportation horizon, and the railway chess-board underwent many startling changes. This disturbing influence was Mr. Charles Melville Hays, who, when he first set foot in Canada in 1899, was a complete stranger to the Dominion. To-day his name is a household word from the Atlantic to the Pacific. Within a decade he has accomplished as much, if not more, than the majority of men achieve in the whole of their lifetime. How he has changed the map of Canada is one of the most fascinating romances of modern times. Through his efforts a new agricultural country, four times the area of the great wheat belt of the United States, has been rescued from oblivion. The veil of mystery has been torn from the northern stretches of Ontario and Quebec, and a new land of Promise has been revealed in northern British Columbia.

His mission to Canada in 1899 was somewhat curious. The first railway built in the Dominion, the Grand Trunk, had fallen on evil days. It was sunk low into the morass of financial difficulty. Sir Charles Rivers Wilson, G.C.M.G., was called upon to rescue it from impending bankruptcy. His administrative capacity enabled him to place his finger upon the weak spot very readily. The railway was operated from London, and controlled by men who knew nothing whatever about local requirements. The obvious remedy was a strong man at the head of affairs on the spot : a man who was familiar with American conditions and ways of doing things.

To find the man he required he was forced to search the United States, as Canada at that time was deficient in railway administrators. In this way his attention became riveted upon Charles M. Hays, who was then trying desperately to accomplish the seemingly impossible. The

Wabash Railway had sunk far more deeply into the mire than had the Grand Trunk Railway. Yet when the new manager appeared on the scene this derelict line was so galvanised into life as to bring prosperity within a measurable distance. This was just the man that the Grand Trunk Railway required, and overtures were made to induce him to transfer his energies from the United States to Canada. They proved successful, and thereupon the "Little American," as Hays was called popularly, assumed the reins of the pioneer iron road of the northern neighbour.

His influence was experienced immediately. He was given a free hand, and was supported strongly by the President in his campaign of overhaul. The result was that the railway was snatched from bankruptcy and once more set firmly on its feet. Some of the shareholders received what they had despaired of ever seeing again—dividends. The whole fabric was torn to pieces and reconstructed piece by piece.

Scarcely had this upbuilding commenced when the Huntingdon group, who saw the Southern Pacific Railway falling into the slough of failure, offered Charles M. Hays the Presidency of that system, in order to retrieve its broken fortunes. Seeing that the topmost rung of the railway ladder was within his grasp, it is not surprising that Hays accepted the offer, especially as it was in connection with one of the most important roads of his native country. He resigned his position in Canada, and once more was soon in the turmoil of overhauling a moribund railway.

However, he had not been many months in his new post before trouble arose. Harriman had secured control of the Southern Pacific, and he and the new President were soon at war. Harriman wanted to handle the concern to meet his own financial ends, and regarded President Hays, as he did all such officials upon his rail-

ways, as a mere pawn in the game. The President, on the other hand, who has been associated actively with the upbuilding of railways all his life, declined to become passive at the behest of the dictator, and to occupy a sinecure. The upshot was that in disgust he tendered his resignation. Thus Hays threw over the reins of the Southern Pacific Railway.

The effect of his guiding hand, however, had been missed sorely from the Grand Trunk Railway, where there was serious danger of the undertaking relapsing into a stage worse than the first. Sir Charles Rivers Wilson, directly he heard of the pending rupture between his old colleague and Harriman, approached the former, requesting him to return to Canada, if he should resign control of the Southern Pacific Railway. Consequently Hays vacated the presidential chair of the one line to assume control of his former charge, where there was unfettered scope for his abilities. That quarrel between the railway financier, Harriman, and the railway organiser, Hays, was one of the most fortunate circumstances for Canada. But for their dispute the history of the Dominion would have been written very differently.

While struggling with the Southern Pacific Hays had been pondering deeply over the railway situation in North America generally. When he saw his pending return to the managership of the Grand Trunk Railway, he devoted his spare time to the elaboration of a thought that had flitted idly through his mind. The inherent evils of the Canadian railway were possible of elimination, inasmuch as they were attributable mainly to mismanagement and errors in construction. By righting these two factors a certain measure of success could be attained, but the possibilities in this direction were restricted severely. The railway system approximated between 6000 and 7000 miles in length, and spread to every corner of Southern Ontario, the most prosperous and settled

province in Canada. But it was insulated. Rival lines had been permitted to spring into existence, and to form a frowning barrier on all sides, hemming in the pioneer line. A great proportion of the revenue accruing from through transportation of passengers and merchandise had to be paid out to competing lines for conveyance to points beyond the zone in which the older line operated. The effect of this disadvantage was being experienced heavily at that time, as the west, with its enormous traffic, was just commencing to boom.

When Hays returned to Montreal, and had completed his arrangements for removing the disciplinary and physical defects incidental to the Grand Trunk Railway, he hurried to London, and revealed his quondam idle thought, which now had assumed definite shape, for solving the problem which had occupied so much of his earnest attention. The encircling competitive and strangling barrier of lines must be broken down, and the necessity for handing traffic over to rivals must be reduced to the minimum. He explained his proposals in a minute, lucid, and comprehensive manner. They were so daring and extensive as to compel attention. A new feeder for the Grand Trunk Railway was necessary, and this could be designed in such a way as to offer an outlet to the west. They were in touch already with the Atlantic, so why should they not have an arm resting on the Pacific ? He suggested building a new trans-continental railway, stretching from coast to coast, running through new territory entirely, and capable of being linked up very easily with the existing network in Southern Ontario. At the same time he emphasised the necessity for establishing a new port on the Pacific coast, which would offer them unrestricted scope for future developments, and where they could secure an unassailable dominating position.

It is a well-worn axiom that British financiers always will entertain a railway transportation project favourably,

being in fact more audacious and enterprising in operations of this nature than Americans, despite the fact that the latter are supposed generally to be more speculative in matters of financial moment. Consequently the new idea was regarded with interest. The crucial point, however, was the feeling of the Canadian people in regard to the scheme, and whether the country and the Government representatives would extend to the undertaking the necessary support.

As a matter of fact, politically there was little to fear. The Liberal Government was in power, and the elaboration of a new trans-continental railway was opportune. The Conservative Party had sanctioned the Canadian Pacific, and, what was more to the point, had stood by it whole-heartedly at the very moment when it was on the verge of collapse though only half completed. True, the Liberals had criticised the Conservative policy in regard to that enterprise most spiritedly. By giving the Liberal Party the opportunity of fostering an even larger scheme after its own heart, the latter would be able to show the Canadian public how justifiable was its hostility towards the methods practised in furthering the completion of the first trans-continental road.

The new manager returned to Canada, having received the approbation of his Directors, who undertook to secure the requisite financial assistance if he could win the Canadian public and Government to his side. The moving spirit decided to feel the pulse of the public first.

The whole of the western country was canvassed religiously by cautious myrmidons. No one knew for whom they were working, or just what the scheme in hand comprised, as it was revealed in a somewhat hazy manner. Secret meetings were held in the cities, large towns, villages, and even in the remote settlements. Extreme caution had to be displayed to prevent any tangible particulars of the undertaking reaching the

rival's ears, inasmuch as the Canadian Pacific regarded the west as its own especial and undisputed preserve. Had an inkling of the fact that the Grand Trunk Railway was contemplating an invasion of the prairie leaked out, competitive interests would have fought the project tooth and nail, with a view to strangling it at its birth.

The whole action of sounding public opinion was contrived very skilfully. It was carried out more on the lines of an agitation for a new trans-continental railway, rather than a supporting propaganda for a scheme already formulated. Consequently the rival line regarded the matter as a perennial topic of academic discussion, and reposed in a false sense of security.

However, the agitation accomplished its avowed purpose. The meetings, once secrecy was thrown aside, were crowded by earnest and hard-thinking farmers, merchants, commercial princes, industrial magnates, and what not. The demand for another line from coast to coast was emphatic, and complete.

Such a line of action appears somewhat novel to British methods, but one must recollect that in Canada things are managed very differently from what obtains here. This project was to develop into an acute political question, to become the sport of an electoral campaign, and many politicians have to obey the behests of certain vested interests, since independence, or a line of thought contrary to the welfare of these influences, is certain to bring about political extinction. After the first few meetings, however, popular enthusiasm assured success for any enterprise of this character. Supporters argued that competition being the life-stream of business, a new coast-to-coast railway was imperative.

The man behind the project, realising how matters were shaping in accordance with his expectations, now approached the Government. He laid his scheme in detail before the Premier and his colleagues at Ottawa.

They listened intently as they grasped the far-reaching significance of the proposals. Finally Charles M. Hays inquired, in his characteristic blunt manner, whether the Liberal Party would stand beside the Grand Trunk Pacific Railway as solidly and firmly as the Conservatives had upheld the building of the first line across the continent ?

The Cabinet pondered deeply. It was a critical issue from their point of view, and they realised that acquiescence in this demand would raise questions of national importance ; that they would have to go to the people, and would have to stand or fall by the proposal. But the convincing testimony of public feeling which the moving spirit offered as a result of his campaign in the west clinched the subject, and Sir Wilfrid Laurier pledged himself and his party to the support of the enterprise, retaining to themselves the right to modify the scheme according to what they considered advisable in the interests of the nation.

Several weeks were expended in threshing out the details of the scheme, the Directors with Mr. Hays ranging themselves on one side, and Sir Wilfrid Laurier and his advisers on the other. The particulars, especially those of a financial character, were drawn up minutely, and several concessions had to be made on either side. There was one point on which the Liberal Party were as adamant. They would extend no free grants of land such as had been given to the first trans-continental railway. This subvention was opposed absolutely to Liberal principles. This constitutes the sole reason why the Grand Trunk Pacific failed to obtain grants of land with its charter, as did the former railway. Canada, like her next-door neighbour, the United States, had suffered from the ill-effects of such short-sightedness on one occasion, and was resolved never to repeat the policy. Moreover, had the Government presented several hundred thousand acres

of freehold to the new enterprise fringing the projected steel highway, she would have parted with some of the choicest land she possessed, as results have proved since.

The details completed to the satisfaction of all concerned, no time was lost in proceeding with the preliminary details. The London market was ripe for the venture, and the British financial world viewed the project with favour.

One morning Canada awoke to experience a thrill of excitement. from the Atlantic to the Pacific. The newspapers announced that a new trans-continental railway was to be undertaken without delay, and that the Grand Trunk Railway was supporting, and indeed was responsible for, the enterprise. It was a bald statement, conveyed to the Press by Mr. Hays himself overnight, but from that moment he became the most discussed man in the Dominion, from Halifax to Vancouver, and from Dawson City to Hudson's Bay. The public clamoured for further information, and in response to this agitation the prime mover's office in Montreal was besieged by representatives of the Press, while telegrams and letters rained in from all corners of the country. But the thirst for further news went unassuaged. Charles M. Hays had fled. After launching his bombshell he had sped southwards to New York during the night, and by the time Canada had recovered from its first thrill he was on the broad Atlantic hurrying to London. In despair the reporters turned to the Government, but no satisfaction was to be gained in that quarter.

The fight now commenced in grim earnest. The Canadian Pacific Railway, realising how completely it had been outwitted by the astute "Little American," who had now become the "Biggest American" in the Dominion, whipped up its forces. It foresaw the threatening of its supremacy in the west, and as the scheme was digested recognised that its traffic was in danger of being

depleted to an appreciable extent. Consequently no effort was spared to bring about the defeat of the new project. The rival's representatives presented a solid phalanx of opposition, and the Parliament Buildings at Ottawa afforded the strangest spectacle of activity in its history.

The ensuing few weeks were the most strenuous in the annals of the Dominion. The Government went to the people prepared to stand or fall by the idea, and the election was one of the most keenly fought in the era of Canadian politics. Critics rose up on all sides and attacked the scheme with venomous hostility, one opponent in describing the ominous outlook for the new venture facetiously remarking that it "would have to borrow the matches to light the fires in its locomotives for all the revenue it could aspire to earn."

Sir Wilfrid Laurier, perhaps the strongest Premier that the Dominion has ever possessed, came boldly into the open. He gave the new enterprise his whole-hearted support, and waged his fight with a strength and determination that surprised his most enthusiastic supporters, and dismayed his most resolute opponents. In a moment he swept public feeling to his side. The dawning Great West, which had been groaning under a monopoly, was to be freed from its fetters; the east was to be brought into closer and more direct touch with the west. The farmer would no longer be at the mercy of a railway octopus. That competition which was so essential to commercial prosperity was to be established. He attracted popular support by stating that the Government would build and own one half of the railway, while Imperial sentiment was stimulated by the announcement that the line was to pass exclusively through Canadian territory from coast to coast, and would thus be an "All-red Route." He lost many adherents from his complete commitment to the scheme, but he gained a greater

number of supporters. As it proved, the Liberal Party scarcely could have gone to the electorate with a more powerful weapon, or a stronger plank in its platform. The party was returned to power with an overwhelming strength.

A considerable amount of opposition had been engineered by interests in the United States which saw in the new railway a stronger bid for independence, and the forging of a stronger link with the British Empire. Some idea of the solemn determination of the Government may be gathered from the words of Mr. W. S. Fielding, Minister of Finance, who, in arguing in favour of the new scheme, remarked: "It is well that we should let our friends across the border understand that whatever measure of independence we now have we shall maintain, and that we shall increase that measure of independence by the link we are now proposing, and that, should the necessity arise, we shall not shrink from providing another."

So far as London was concerned the Directors had lost no time while the preliminaries were occupying so much attention on the part of the Canadian people. The arrangements for providing the first instalment of capital on behalf of construction were concluded through two well-known banking houses, Messrs. N. M. Rothschild and Sons and Messrs. Speyer Brothers, the issue of bonds being subscribed ten times over. The surveys likewise were hurried forward, Mr. Hays enrolling his own staff recruited from the finest men available for this peculiar work in America and Europe. These arrangements had to be modified somewhat upon the Canadian Government undertaking to build one half of the line, the surveys completed by the Grand Trunk Railway east of Winnipeg being purchased subsequently by the Government for $352,191 or £70,438.

With regard to the Government support this assumed tangible proportions. So far as the national section,

stretching from Moncton to Winnipeg, a distance of 1801 miles, is concerned, the Government are defraying the cost entirely. Upon completion it is to be leased to the Grand Trunk Pacific Railway for a period of fifty years, in return for an annual rent representing 3 per cent on the outlay. This only applies to the main line, as all branch lines or feeders are to be constructed at the expense of the company.

Bearing in mind the fact that national undertakings proverbially are more expensive than similar works completed by private enterprise, it may be thought that this is a somewhat ambiguous arrangement, whereby the company may be called upon to pay a rental upon a sum quite out of proportion to the value of the line itself. But as a matter of fact, capital cost cannot be inflated unduly. Although "cost of construction" seems an elastic phrase, in this case it is construed as meaning the "most economical basis consistent with the building of a first-class railway," such as it was decided to provide. This affords adequate protection to the company, as the chief engineer of the latter had the controlling voice concerning specifications, which were submitted for his approval before work was commenced. In other words, he governs the question of expense and decides what is a legitimate outlay for the achievement of the task.

However, as the line traverses new areas of country, where development has to take place, and traffic has to be created to provide the requisite income, the Government has extended a period of seven years for this purpose, during which term the company is not to be called upon to pay any rent, but merely to defray the cost of maintenance or "working expenditure." At the end of that period the rent becomes due, and is payable till the end of the term. In the event, however, of the traffic not becoming sufficiently remunerative to defray the rent, then the difference between the sum paid and that due

is to be added to the capital cost, and is to bear 3 per cent interest per annum, after the first ten years of the lease. By this arrangement the company secures the free use of the line for seven years from the date it takes the complete scheme over, the sole expenditure during that period being on account of working expenses.

When the lease expires the Government has the option of working the railway as a national concern, but should the Government decide against this course, then the company is entitled to a further lease of fifty years. In the event of the first line of action being taken, the company is to be permitted such running powers and haulage rights as may be necessary to secure connection between the Grand Trunk system and the lines west of Winnipeg.

The only subvention the company has secured is that from the Provincial Government of Ontario in respect of the branch line 188·8 miles in length, extending from Fort William, at the head of Lake Superior, to Lake Superior Junction on the national section of the railway, 245 miles east of Winnipeg. The construction of this branch was attended by a subsidy of $2000 or £400 per mile, with a land grant of 6000 acres per mile.

The Government also decided to assist in the construction of the Grand Trunk Pacific western section, i.e. that from Winnipeg to the Pacific coast, the two moieties of the line being known respectively as the eastern and western divisions, with Winnipeg as the central point. But in view of the fact that the first 916 miles west of Winnipeg traversed the plains, where the physical characteristics offered no supreme obstacle to construction, the western division was subdivided into two sections, the first, extending to Wolf Creek, being known as the "Prairie Section," and the second, reaching from Wolf Creek to Prince Rupert, as the "Mountain Section." The whole of this western division is

being constructed by the company, but the Government are guaranteeing the First Mortgage Bonds, principal and interest, to the extent of $13,000 or £2600 on the "Prairie Section," for fifty years, and 75 per cent of the cost of construction, whatever it may be, on the 840 miles of the "Mountain Section," where construction is certain to be highly expensive, for a similar period, the Grand Trunk Railway being responsible for guaranteeing the bonds, principal and interest, of the balance of the cost of construction, similarly for fifty years.

The interest on this underwriting commences from the time the road is completed and opened officially, but during the first seven years of this period, owing to the company having to create its traffic, the Government is paying the interest on its guaranteed bonds concerning the "Mountain Section" without calling on the company for the money thus expended. Should the company be unable to defray the interest during the ensuing three years, the Government is to pay the same, and upon the expiration of the first ten years any defaulting interest incurred during the three years' grace is to be added to capital and bear interest at 3 per cent. Should the company meet with such misfortune as to prevent it paying interest for any period of five years after the first ten years have expired, the Government is to co-operate with the company, and to their mutual satisfaction a manager is to be appointed to direct the undertaking. Then the net earnings are to be divided between the holders of the Government guaranteed bonds and those of the Grand Trunk Company's guaranteed bonds in the proportion of 75 per cent to the former and 25 per cent to the latter.

It will be seen that the people of Canada have, almost unanimously, come to the assistance of this undertaking, and the financial arrangement cannot be described as other than equitable. It is a co-operation which tends

to secure all possible support for the enterprise, and the substantial interest which the public possess therein is certain to result in as much traffic as possible being turned into this channel.

This was the manner in which an idle thought evolved into the most stupendous railway constructional enterprise in the history of the iron road. To undertake 3543 miles of first-class railway as one concrete project represents a colossal task, especially when it is recalled that at the time of its conception the population of the Dominion did not exceed 6,000,000 souls. The Cape to Cairo may be a more ambitious enterprise, but it is being built in distinct units. The trans-Siberian line may be a longer line, but it was attacked in sections, and pushed from coast to coast. The completion of the formalities which rendered the fulfilment of this vast Canadian project possible is a striking tribute to the foresight and energy of one man, Mr. Charles Melville Hays, who has earned rightly the distinction of being the "Cecil Rhodes of Canada," with the probability of seeing his dream realised during his lifetime. Should the project be completed, he will have the unique distinction of controlling the greatest network of railways in the world, for the systems of the Grand Trunk Pacific and the Grand Trunk Company will aggregate no less than 16,550 miles.

CHAPTER II

THREADING NEW TREASURE LANDS FROM COAST TO COAST

WHEN the project made its bow to the public it provoked considerable criticism, which for the most part was of a pessimistic, if not of an avowedly hostile, character. The line was too far to the north—it traversed country beyond the limits of human endurance, so how could civilisation and development take place? How could the line hope to earn sufficient to pay for the matches to light the fires in the locomotives?

By consulting the map cursorily such an argument appears justifiable, for the eastern half of the line lies entirely between the 45th and 50th, while the western section runs between the 50th and 55th parallels. Twenty years ago people who claimed the knowledge vehemently protested that wheat could not be grown on the prairie north of the 50th degree of latitude. But that fallacy has been exploded completely. As a matter of fact, the best grades of wheat, and the most arable land in the Dominion adapted to cereals, lies beyond the long-accepted northern limit. A great stretch of the country south of this line is not adapted naturally to the raising of crops—the country is sterile practically, and the farmer has to resort to irrigation. But as one ventures farther north the country is found to be watered more freely, both by rivers and large lakes. Consequently the soil is richer and more juicy, containing just those constituents in plenty for the growth of grain under the most promising conditions.

Investigation of the dormant wealth of this land caused the promoters of this enterprise to keep the line well to the north, so as to open up a new country in the widest sense of the word. That it has been a wise policy is revealed by the results achieved already upon this "inhospitable prairie," as it was called deprecatingly. A new grain-growing country aggregating in area some 300,000,000 acres was discovered. It is difficult to say just how far north this great agricultural belt extends, but it is to a point well beyond the 55th parallel. In fact, some of the finest wheat the farmer could ever hope to harvest is raised on the shores of Hudson's Bay.

More astonishing, perhaps, is the wonderful development that is taking place in the extreme west. During my recent journey across the continent I came face to face with an unusual spectacle. Prairie schooner after prairie schooner—the quaint western springless, horse-drawn waggon—laden to breaking-point, and handled by grim, sturdy pioneers, was pushing northward from Edmonton and a dozen other points beyond along the uncompleted section of the Grand Trunk Pacific Railway so far as Edson. What was their destination? Why, the Peace River country, some 700 miles north of the Grand Trunk Pacific Railway. It appeared incredible, but, as a matter of fact, a far richer, and far more attractive, agricultural country than that between the 50th and 55th parallels has been found beyond the latter. And this new territory is self-supporting. The Hudson's Bay Company has known of its value for years, and at one of its posts has a flour-mill at work. Everything grows there in abundance. At Fort Chipewyan, on Lake Athabaska, near latitude 60, a temperature of 100 degrees in the shade is recorded frequently for days and nights continuously. It is the land of the eighty-five-day wheat. This country has been neglected for so many years only because there were no railway facilities. At the Centennial

Exposition held in Philadelphia so far back as 1876 the first prize for wheat was carried off by an exhibit raised at Fort Chipewyan, and the successful winner, hale and hearty, is yet a familiar figure at this remote outpost of civilisation. Farther north still, at Fort Vermilion, a similar condition of affairs exists. For nearly thirty years this Land of Promise was forgotten completely. To-day, however, the pioneers are pouring into the territory fringing the mighty Peace River, where the Government has reserved some 10,000,000 acres for the daring homesteader, simply because they have heard that the Grand Trunk Pacific intends to traverse the territory. The first trek arose from the surveying engineers devoting so much energy and time to the survey of the Peace River Pass as a possible gateway for the railway to the Pacific coast, a route which was abandoned only after prolonged deliberations, and for strategical reasons, in favour of the Yellowhead Pass.

The extraordinary influx of settlers to the new country opened in the west by this railway, which is without a parallel on the North American Continent, has been attended by a curious sequel which demonstrates the inconsistency of human nature. The very people who ten years ago assailed the Grand Trunk Pacific Railway for locating its line so extensively north, to-day are asking why the line was not placed still closer towards the Arctic Circle!

So far as British Columbia is concerned, a similar condition of affairs was responsible for the coast being gained at what appears to be a remote and inaccessible point. A decade ago this territory was regarded as a closed book. The atlases of the closing years of the last century describe it as a country only adapted to trapping and hunting, with locomotion by canoe in summer, which was very short, and by dog-sleigh and snow-shoes in winter, which was stated to be long and severe. As

a matter of fact, the winter in these northern latitudes is far milder than that experienced in the northern United States—the Dakotas, Minnesota, and Wisconsin. The northern coast washed by the Pacific, like Great Britain, is benefited by a phenomenon of Nature which tempers the rigours and severity of winter. In the case of the British Isles it is a warm river of water from the tropical Gulf of Mexico ; in the case of northern British Columbia and Alaska it is a warm current of air—the Japanese chinook wind. So far-reaching are the results of this favourable factor, that, in some parts of New British Columbia, stock can graze in the open the whole year round, while many lakes are free from ice in midwinter.

In reality the most inhospitable country traversed by the railway is that comprised in the northern stretches of the provinces of Ontario and Quebec. But the line was kept well to the north for several reasons. In the first place, the country adjacent to the Great Lakes is extremely cold during the winter, which here is Arctic indeed in its severity. Then again, the land is broken extremely both by rock and water in the vicinity of Lake Superior. The engineers engaged in building the Canadian Pacific found the comparatively short stretch between Port Arthur and Sudbury so beset with tremendous difficulties that they well-nigh despaired of ever getting through. The task was far more arduous than that of penetrating the formidable Rocky, Selkirk, and Cascade Mountains, while the cost ran to a very high figure per mile.

When the Grand Trunk Pacific was conceived it was resolved to profit by the experience accumulated while building the first trans-Canadian railway, and consequently the line was kept well inland. By so doing full advantage was taken of physical conditions. The land slopes somewhat abruptly from its greatest height to the shores of Lake Superior. On the opposite side it shelves very

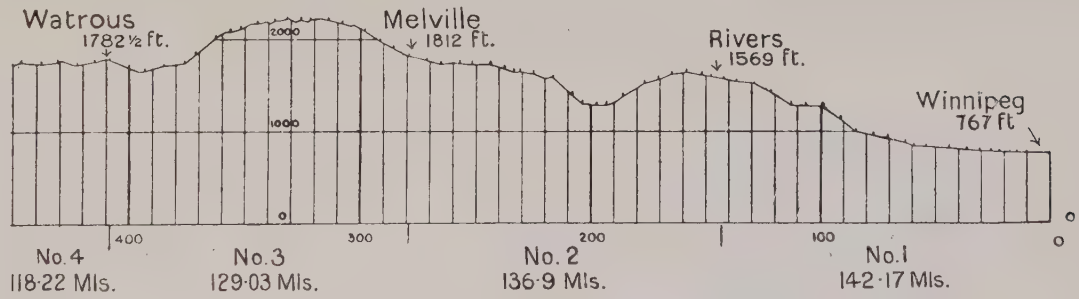
gradually to James Bay, the large indent on the southern shores of Hudson's Bay. Then again, the climate was found to be milder on the north than on the south side of this rocky wall, while the coldness experienced was found to be due, in a very great measure, to the locked-up condition of the country, for the forest is dense and practically interminable. The sun being unable to penetrate the vegetation is denied the possibility of shedding its genial warmth upon the soil, with the result that Jack Frost reigns supreme virtually the whole year round, the soddened, thick layer of decayed vegetation constituting the top soil yielding solid ice but a few feet below the surface on midsummer's day!

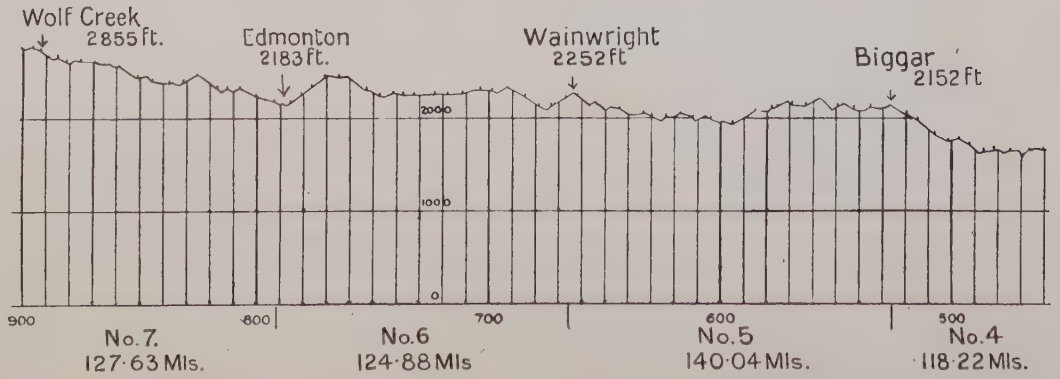
This fact was demonstrated to me in a convincing manner by one of the engineers. It was the middle of June—the longest day was scarcely a week distant—and the engineer drove his spade into the peaty mass. As he dug down he turned up thin layers of solid ice, the water in all the pockets being frozen solid. We were in the dark, dense forest, and although the sun in the open was unbearable, beneath the trees the temperature was that of an ice-well. The sun's rays had not touched this ground possibly for scores of years—certainly not since the young trees which sprang up after the fire which, according to Indian legend, devastated the whole of Western Ontario, once more shut in the ground beneath.

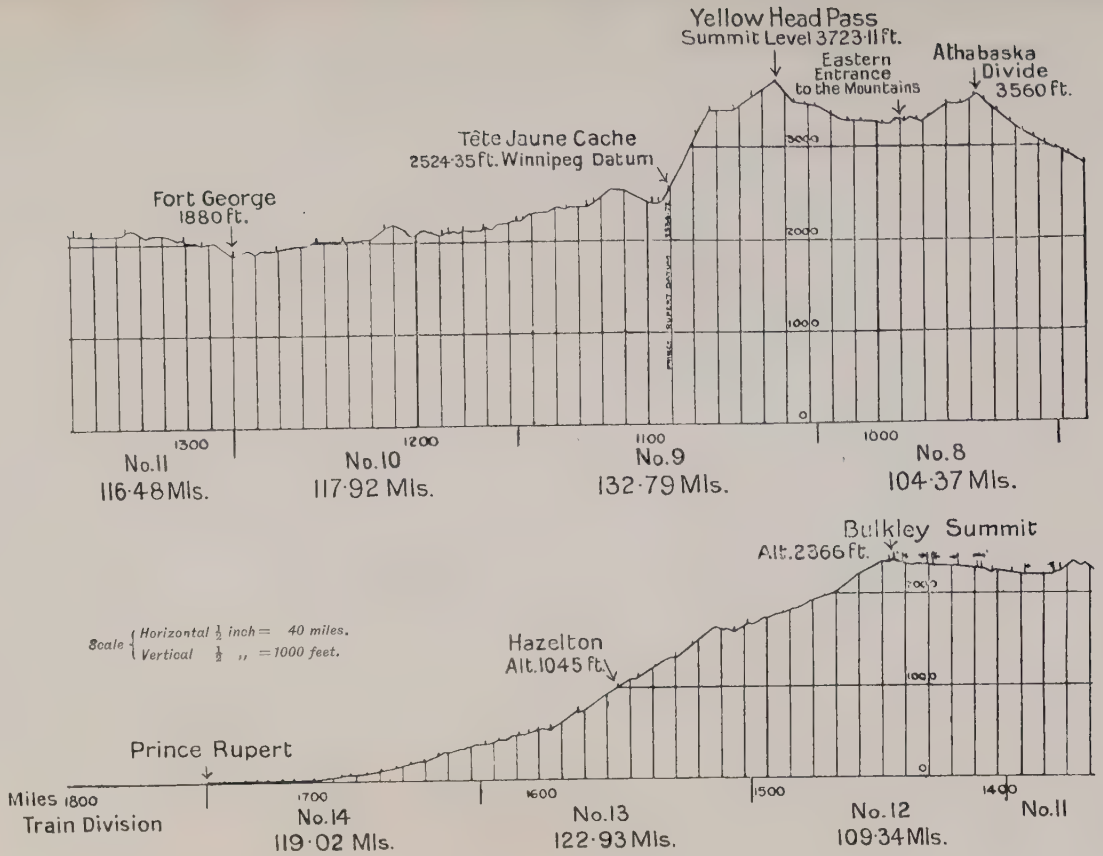
Such a state of affairs may appear alarming, but the same conditions prevailed when the railway engineers entered Southern Ontario in the 'sixties to build the first link in what is now the Grand Trunk Railway system. Ice and frost held the country the whole year round beneath the branches of the trees, yet in that country peaches, grapes, and other delicate fruits now are grown prolifically in the open air. And the same metamorphosis is being wrought in the northern stretch of the province pierced by the new trans-continental railway.

PROFILE OF THE GRAND TRUNK PACIFIC RAILWAY, 1742 MILES, BETWEEN PRINCE RUPERT AND WINNIPEG

The Rocky Mountains are crossed at the Yellowhead Pass at an elevation of 3723 feet, the lowest level at which this range is crossed by railway. Between Prince Rupert and Wolf Creek, although the line threads 840 miles of mountain country, the ruling grade against both east- and west-bound traffic is only 0·4 per cent or 1 in 250, while the sharp st curve is of 955 feet radius. On the prairie section between Wolf Creek and Winnipeg the ruling grades are 26·4 feet per mile against we-t-bound and 21·12 feet per mile against east-bound traffic. The 1756 miles of track are divided into fourteen train districts. At these divisional points trains change engines, the district indicating the extent of one locomotive's work.






Yellow Head Pass
Summit Level 3723·11 ft.
Eastern Entrance to the Mountains
Athabaska Divide 3560 ft.
Tête Jaune Cache
2524·35 ft. Winnipeg Datum
Fort George
1880 ft.
3000
2000
1000
0
1300
1200
1100
1000
No.11
116·48 Mls.
No.10
117·92 Mls.
No.9
132·79 Mls.
No.8
104·37 Mls.
Bulkley Summit
Alt. 2366 ft.
Scale { Horizontal ½ inch = 40 miles.
Vertical ½ " = 1000 feet.
Hazelton
Alt. 1045 ft.
Prince Rupert
Miles
Train Division
1800
1700
1600
1500
1400
No.14
119·02 Mls.
No.13
122·93 Mls.
No.12
109·34 Mls.
No.11

The maximum altitude between the Great Lakes and James Bay, however, is not excessive. North Bay Junction, on Lake Nipissing, lies 654 feet above the sea. Travelling northwards practically in a straight line over the Temiskaming and Northern Ontario Railway, the "height of land" is gained 18 miles beyond; and then only represents 1222 feet above sea-level. The highland plateau continues for about 70 miles with an almost imperceptible declination northwards, followed by a slightly sharper descent and rise, spread over 70 miles, to an altitude of about 1000 feet, whence there is a steady fall, so slight as to be practically inappreciable, for about 245 miles to the shores of James Bay, the country throughout being gently undulating. By setting the line of the Grand Trunk Pacific Railway apparently so far north, therefore, advantage was taken of the configuration of the country, which lends itself to the construction of a road-bed fluctuating so slightly and gradually as to be almost level.

Apart from the excellence and location of the route through wholly new country presenting golden opportunities for development, and obviating the necessity of dividing any revenue arising therefrom with a competing railway, a more startling proposition was decided upon. Hitherto trans-continental railways on the American continent had been built in a somewhat haphazard manner. The line was generally pushed through the country as quickly as possible, following the path of least resistance, and without any due regard to grades and curves. Construction itself was of the roughest description, comprising merely the raising of the requisite longitudinal ridge on the crown of which the metals were laid roughly. The idea was to reduce the initial expenditure, and then to overhaul and improve the line to meet the exigencies of increasing traffic. But it is a highly expensive process notwithstanding, inasmuch as overhauling entails an expenditure sufficient to rebuild the original line three

or four times over. Nowadays it is difficult to improve the standard of a railway track built indifferently in the first instance hand-in-hand with the march of progress in locomotive practice.

But Charles Melville Hays had been drilled in the new school, and had learned the fallacy of such procedure. It had been responsible in a great measure for the decadence of the many lines whose prosperity he had been called upon to resuscitate. Moreover, he had taken the late President Cassatt's famous dictum, "the Straight level line wins," seriously to heart, and that it was profitably successful his experience in overhauling the Grand Trunk Railway has shown conclusively. Consequently, when the new scheme was launched, he resolved to make it a model railway in every respect, and that first cost should be last cost. The British railways were his models, and he strove to build such a line in the first instance. He was warned that it would prove terribly expensive, and that it would be feasible to build a line sufficient for present-day requirements for a third of the cost. But he was supported by his Directors, and fortunately the Canadian Government saw eye-to-eye with him.

The result was that a high-grade specification was drawn up, and this is being fulfilled strictly to the letter, though it is involving the expenditure of millions to achieve the ideal. Also it has prolonged the time required for the consummation of the work, for circumstances have developed which no human effort could foresee, and which are inseparable from an undertaking of such a magnitude as this. Two features in connection with the line stand out very decisively—grades and curvatures. Nothing ate so ravenously into railway earnings as these two adverse elements, and one defect is almost as disastrous as the other. The former militates against the individual haulage capacity of a locomotive and train, while the second affects speed.

The Grand Trunk Pacific Railway called for the irreducible minimum in both cases. Grades were not to exceed four-tenths of 1 per cent, or 21·12 feet per mile, while no curves were to be sharper than four degrees, that is of 1432·5 feet radius. These desiderata were criticised severely. Although it was admitted that such might be perfectly feasible on the prairie, critics maintained that such a grade through the Rockies and Cascades was a sheer physical impossibility. Consequently there was a general feeling that though the Grand Trunk Pacific might cherish the desire for a grade of only 21·12 feet per mile through the mountains, they would be lucky indeed if, when they came to close grips with Nature in that country, they escaped with grades easier than 52·8 feet per mile. But the critics have been confounded! The railway threads the mountains with a "ruling" grade of 21·12 feet per mile, against both east and west-bound traffic. How this easy pathway through such forbidding mountainous masses as the Rockies and Cascades was discovered is related in subsequent chapters.

This fight for low grades on the North American continent is one of the most salient characteristics incidental to railway engineering in that country, and rises not exceeding 52·8 feet per mile have been sought diligently. This rise appears insignificant, especially when compared with some of the grades upon existing trans-continental railways, which range up to 4 per cent, or 208 feet per mile. As a matter of fact, the maximum or "ruling" grade is vital to railway economics. It governs the hauling capacity of a single locomotive in a train district or division. For instance, suppose on this division, measuring about 120 miles in length, there are stretches of level track broken up by banks having a rise of 1 per cent or 52·8 feet per mile. On the level sections the engine can haul, say, thirty trucks or cars, but whenever it reaches the 1 per cent bank, which is beyond its capacity, one of

two methods has to be adopted. The train either has to be divided or assisted up the bank by another engine. In any case, the cost of operation is increased to a certain extent. The efficiency of the line is reduced to what load the single, unaided engine can handle on the 1 per cent grade. This factor has been demonstrated very strikingly upon the "Big Hill" of the Canadian Pacific Railway, which lies between Hector and Field in the Kicking Horse Pass. This bank, 4½ miles in length, had a rise of as much as 4·4 per cent; that is to say, 232 feet to the mile. In order to overcome this bank it was no unusual sight to see as many as three or four locomotives laboriously hauling and pushing a train at a mere crawl, whereas elsewhere a single engine could handle the load satisfactorily. In course of time the existence of this "heavy pull" became such a drag upon the efficiency of the railway that it was decided to reduce it. As a result the Canadian Pacific Railway was realigned through the Kicking Horse Pass at a cost of $1,250,000, or £250,000. By the execution of a striking piece of engineering work the "Big Hill" was doubled in length, but its gradient was reduced by just one-half.

Coming to the Grand Trunk Pacific Railway, a striking illustration of the economic value of the 21·12 feet per mile graded based upon actual and practical results can be given. The Inter-Colonial Railway, extending through the lower provinces of Canada from Montreal to the coast, has a "ruling" grade of 1 per cent. For our purpose we will take a locomotive of the consolidated type weighing 107 tons, or, as it is technically expressed, "with 53 tons on the driving wheels." This is not the largest type of locomotive used to-day on Canadian railways, but being one in extensive vogue is the best for the purpose of this comparison. Such an engine can haul, over a grade of 1 per cent—52·8 feet per mile—a train representing a weight of 810 tons. Yet on the level the

same locomotive can handle a train-load of 3869 tons. In other words, the existence of the 1 per cent grade reduces the hauling capacity of the engine by more than 75 per cent. Now place the same train on the Grand Trunk Pacific Railway with its grades of four-tenths of 1 per cent, and a marked difference is noticeable. The hauling capacity of the engine is increased to 1596 tons. That is to say, by reducing the severity of the bank from 52·8 feet to 21·12 feet per mile, the hauling capacity of the engine is double, practically, that on the former, and slightly less than one-half of the maximum possible under the most favourable conditions—a perfectly level track. From this the significance of the easy grade may be realised, and it is possible to comprehend why the railway engineer of to-day strives so valiantly for the easy-level line.

The stipulations set out by the powers responsible for the realisation of this new trans-continental railway were therefore of a very stringent character, and presented an exacting task to the surveyors. Yet it was found possible to meet the demands of the moving spirit almost in their entirety. Here and there the physical conditions were such as to render it exceedingly perplexing, unless a fabulous amount of money were spent. Then the question arose as to whether the easy grade was worth the heavy outlay demanded. For instance, the rise westward from the city of Quebec, owing to the geographical situation of this port, is exceedingly abrupt. The surveyors could fulfil the official fiat, and offered a route within the four corners of the limitations, but such would lengthen the mileage by some 19 miles. Also, when the matter was investigated it was found that it would cost $500,000, or £100,000, and add something like $750,000, or £150,000, in capitalised operating value than an alternative, shorter route having a steeper grade. The insertion of the latter approximately entailed a

rise of 1 in 90 for a distance of 10 miles, acting adversely against traffic flowing towards the Atlantic.

Again, in New Brunswick another similar situation arose. By the introduction of a grade averaging 58 feet per mile for a distance of some 12 miles, the route could be shortened by 17 miles, $2,000,000, or £400,000, could be saved in constructional costs, together with $1,250,000, or £250,000, in capitalised operating value. The matter was threshed out thoroughly in all its bearings, and finally it was decided to introduce these two steeper grades temporarily. Should they be found to react too adversely upon the working efficiency of the line, then the track could be rebuilt over the easier, longer route at leisure, and thereby bring the whole into uniformity. In the Rockies the issue once more reappeared. The descent from the summit level in the Yellowhead Pass has to follow the Fraser River from its tributary source in Yellowhead Lake. The river drops so suddenly and continuously during 50 miles that it was found physically impossible to preserve the easy grade throughout the whole distance, inasmuch as Tête Jaune Cache must be reached in order to enter the Fraser River Valley. A short section of 1 per cent grade adverse to traffic flowing from the Pacific has had to be introduced. In each instance one additional engine stationed at the foot of the bank will suffice to help the train over these " pusher grades," as they are called.

In the early trans-continental railways, in order to preserve the grade across deep, wide valleys, extensive recourse was made to timber trestling. It was decided that such should be eliminated entirely from the Grand Trunk Pacific Railway, owing to the dangers of destruction and possible accidents from fire, and also because of the relatively short life of such structures. Steel and concrete were to be used exclusively. In the course of building the western section of the line, however, this decision

had to be modified slightly to meet peculiar and unexpected conditions. It was found absolutely impossible to secure the delivery of the requisite steel-work on time, so, instead of delaying the progress of the railway, the depressions have been spanned in certain instances by timber trestles. Such, however, are purely temporary, and so fast as the steel-work can be brought up, the metallic structures are being erected, the timber used temporarily being buried beneath millions of cubic yards of ballast brought at leisure from different points.

CHAPTER III

The Reconnaissance in the Wilderness and how the Railway Line was Discovered

THE first step in this great work was the reconnaissance, the surveyors being deputed to run rapidly through the country so as to secure a general impression of the topography, and the direction the line should take to secure the requisite alignment in point of easy grades and curvature. This in itself was a daring piece of work. It entailed scouting through a vast territory some 1800 miles in width, the greater part of which was unknown. In fact, at that time more was known about the land lying around the North Pole than of the northern stretches of Ontario and Quebec. True, there were Government maps, but the knowledge they contained was confined to the country lying immediately contiguous to the great rivers, which could be followed from their junction with the St. Lawrence for hundreds of miles up-country. But as these rivers ran at right-angles to the route which the line was to follow, this information was of slight utility.

Then there was another perplexing problem—the entrance to this northern territory. For the most part it was absolutely inaccessible. It was foreseen that at some places in Ontario the reconnoitring forces would be called upon to carry out their work some three or four hundred miles beyond the limits of civilisation. So far as the Lower Provinces were concerned, the reconnaissance was not beset with such grave difficulties. New Brunswick and Nova Scotia are the two oldest settled and most

developed provinces in the Dominion, and although at places the scouts were obliged to push their way through country where the trapper and lumber-jack reigned supreme, still they were never many miles beyond the pale of civilisation and settlement.

On the other hand, in the unknown inaccessible northern stretches of Ontario and Quebec the Indian still held undisputed sway. Here and there were Hudson's Bay trading posts, which constituted convenient centres, for the famous Fur Company has a splendid system of intercommunication between its isolated posts and Montreal. But it was necessary for the surveyors to gain points far remote from such diminutive civilised points in the wilds, and to carry out their work buried in the depths of the forest with its impressive feeling of isolation.

The average person speaks lightly about the backwoods of Canada and their fascinating glamour when discussing the subject from the perspective of a few thousand miles in a cosy arm-chair, and without personal knowledge of the topographical conditions. But when one, like myself, has penetrated the wilderness, has torn the veil of romance and adventure aside roughly, revealing prodigious difficulties of every description, perils untold, privations unheard of, and a silence and loneliness that bludgeons the senses into inactivity, then the picture assumes a totally different aspect and colouring.

In order to obtain a faint idea of the prospect that confronted those entrusted with the reconnaissance, conceive a vast country rolling away in humps, towering ridges, and wide-yawning valleys as far as the eye can see, and with the knowledge that the horizon can be moved onwards for hundreds of miles without bringing about any welcome break in the outlook. On every hand is the interminable forest, a verdant sea, except where here and there jagged splashes of black and brown betoken that the fire fiend has been busily at work. The trees swinging

wave-like before the breeze conceal dangers untold beneath their heavy blanket-like branches, the existence of which are beyond contemplation until one is brought to close grips with them.

Here it is a swamp whose viscous, treacherous mass stretches for mile after mile to all points of the compass, until it attains an area sufficiently large to absorb an English county. There it is a litter of jagged rock as if Nature had been at play with the mountains, and after pulverising their solid masses had tossed the debris promiscuously on every hand. Covered with slippery, decaying vegetation their surfaces are as dangerous as orange peel on an asphalt pavement, and a slight slip may result easily in an ugly contusion or a badly broken limb. Could one survey the scene of solemn grandeur presented by the vegetation from a coign of vantage, nothing could be seen of the maze of fallen tree trunks, levelled by wind, water, and fire, piled up beneath the trees to a height of ten, fifteen, and twenty feet in an inextricable mass, and over which one has to make one's way with infinite labour, menaced with danger to life and limb.

The forest is trackless save for narrow pathways, some of which are scarcely distinguishable, and all merely inches in width, wandering in apparent aimlessness through the gloom to one knows not whither. Maybe they come to a dead stop on the brink of a gulch, at the bottom of which a broad river is tearing along fiendishly. The opposite bank is one's objective, and there is no bridge to afford communication. In order to cross one must be dependent upon individual resource in contriving a flimsy vehicle, and even when afloat one must possess considerable presence of mind and skill in battling with the fierce current, sunken jagged rocks, snags, timber jams, sandbars, roaring rapids and whirlpools. One carries his life in his hands the whole time, certain in the knowledge that at any moment he may be called

upon to battle for his life when his bark comes to grief and disappears from beneath his feet.

One cannot wander far from the trail beaten down by the moccasined feet of the Indian without having to fight his way foot by foot with the axe, for the bush stands up impregnable, and bristling with snags. Advance must be made warily to avoid sudden immersion in a swamp, while if astride a pack-horse he must be ever on the alert to spring clear the moment one's mount gets into difficulties. In summer the ground is well-nigh impassable, for it is as soft and treacherous as quicksand, and advance is reckoned in yards per hour. In winter, when the ooze has become hardened by the grip of frost, and snow has covered the whole with a thick pall, progress is easier and more rapid. But winter brings fresh dangers peculiarly its own. There is the blinding blizzard, the relentless drift, the slush which superficially appears sufficiently strong to withstand one's weight, but collapses beneath one's feet and leaves one floundering waist-high in a freezing slough. Then there is the cold—the pitiless low temperature which penetrates the thickest clothing, for when the thermometer is hovering about 35 degrees or more below zero, supreme ingenuity is required to keep the blood circulating through one's veins, and to avoid that terrible enemy, frost-bite.

Not a sound breaks the eternal silence beyond the sighing of the wind through the trees, the rifle-like crack of a dead, gaunt monarch as it crashes to the ground, or the howl of the wolf. Not a soul is met save a stray Indian or a trapper at rare intervals. Should accident or disaster befall one, news thereof would not trickle through to the outside world for months, if it ever did at all.

Such was the country which the surveyors were called upon to explore, from which the veil of mystery was to be torn, and thrust farther back towards the Arctic

Circle. It was an appallingly forbidding prospect, and reconnoitring demanded men of exceptional calibre and perfection in their work. They were selected with infinite care by Mr. Hugh Lumsden, who was appointed the engineer-in-chief over the Government division. His unique experience in connection with the location of railways, and his extensive knowledge of the conditions against which the men were likely to be pitted, contributed in no small measure to the complete success with which the surveys were carried through.

For the sake of convenience the round 1800 miles between Moncton and Winnipeg were subdivided into sections, averaging about 314 miles in width apiece. Those in the more settled districts were somewhat larger, in order to reduce the mileage in the more inaccessible country. A responsible, accomplished engineer was placed in charge of each district, under direct control of the chief at Ottawa. By this arrangement Mr. Lumsden was enabled to keep survey work in progress over the whole 1800 miles at various points simultaneously, and the location of the line was brought to a satisfactory conclusion within the shortest possible time. When the work was in full swing there were forty-five surveying parties in the field, each comprising a small colony of eighteen men, so that a total scouting army of 810 men was scattered over half of the Dominion busily engaged in plotting the path for the railway.

The reconnaissance, however, was the most adventurous part of the undertaking, inasmuch as the men, for freedom of action and celerity in movement in this phase of the operations, had to be equipped as lightly as possible. They were given a roving commission, for in addition to pushing their way directly through the country along the route which the authorities wished to follow, and which was indicated in its broad lines, they had to wander for 50 to 100 miles over the land on either side.

For the purpose of the reconnaissance only those possessed of robust constitutions, abundant resource, fearlessness, and, above all, to the manner born in regard to locating railways, were selected. One and all possessed what is called "an eye to the country," that is, the inherent ability perfected by prolonged experience to indicate the broad path of the line from hurried observation. Moreover, they were capable of finding their way anywhere, irrespective of conditions, had no fear of being lost, and even if such should happen, possessed the ability to extricate themselves from their unfortunate position, and were able to pick up once more the line of their work. They had to be prepared to pull themselves from tight corners time after time, contented to rough it to the most acute degree, and not to be dismayed when compelled to subsist on short rations.

To facilitate rapid movement the surveyor reduced his encumbrance to the minimum. Generally he was accompanied by one assistant, and possibly one or two other men to extend aid when required. Their instruments comprised aneroid barometers to take and record altitudes, a compass to give direction, while distance either was estimated or paced. Moving rapidly through the country, they became acquainted with its general physical characteristics and of the difficulties which would have to be overcome in construction; and noted the approximate situations of swamps, rivers, lakes, and so forth, and whether the country was forest, open, or rocky. When they came to a river they had to cross it as best they could, fashioning rude rafts from dead logs, which were lashed together, and in which they poled their way across the waterway. The latter always was exciting, for the Canadian waterways are so treacherous that a thrill may be expected confidently at every turn.

There was one adverse circumstance which these reconnoitring surveyors realised before they had pro-

ceeded very far. This was the utter unreliability of the Government maps which they carried. These had been prepared only perfunctorily, and upon the flimsiest information. Rivers were indicated in the wrong places, lakes shown where they did not exist, while blanks representing apparent dry land were found to be broken up with sheets of water and creeks. These maps were discarded in disgust, the surveyors compiling their own as they advanced. Consequently, in addition to investigating the country in the search for the location of the line, these little colonies contributed materially to the geographical knowledge of the unknown interior by their cartographic work.

The reconnaissance having been completed, the preliminary lines were run. Now, although the length of the line through a certain district may represent only, say, a matter of 100 miles of construction, possibly four lines representing from three to six times that mileage were prepared by the surveyors before the most advantageous route was found. For instance, to decide one section of approximately 290 miles, 1535 miles of exploration were made, and 1521 miles of preliminary lines were driven. In another case 1080 miles of exploration were carried out, while 1064 miles of preliminary lines were run to obtain a length of 433 miles of the completed line. Before the precise direction of the line between Moncton and Winnipeg was decided definitely, giving a railway 1801 miles in length, the surveyors carried out over 10,000 miles of exploration, preliminary and location lines, in the search for the most satisfactory route from all points of view.

In prosecuting the second stage in the survey the chief surveying-engineer was accompanied by the rest of his party; the work was carried out more thoroughly; distances were measured by the chain, while the transit and level were brought into requisition to ascertain levels.

Though this work had to be carried out carefully, yet extreme exactitude was not demanded, but just sufficient knowledge to enable the next step to be made profitably.

The preliminaries finished, the "first location," that is a possible route for the line, was made. The party, at full strength of eighteen all told, now moved along very carefully from point to point. In addition to the chief surveyor and his assistant, with the transit, there were the leveller, topographer, draughtsman, rodman, picket man, two chainmen, a number of axemen to clear the way, and last, but by no means least, the cook, upon whose culinary skill the harmonious working and general content of the little colony depended to a far greater degree than appears to the eye.

As the men proceeded with their first location the work was committed to paper, the profile of the country and the line being drawn exactly to scale on the spot, while full information concerning the character of the country, its geographical formation, sites for bridges, and so forth were set out in detail, so that some estimate of the cost of construction might be obtained.

In addition to plotting the line the surveyor also had to fulfil another very important function. It is not sufficient that a railway merely should cross a country; it must possess a certain amount of possible economic value to contribute to the revenue and earning capacity of the road. As a result the surveyor had to give comprehensive information as to whether the country on either side of each "first location" offered any attraction to commercial development from either the agricultural, mineralogical, or any other point of view. In short, he had to supply not only a route for the line, but an encyclopædia upon the possible resources of the country traversed as well.

Several "first locations" were prepared in this manner, and the work was forwarded once a month to the

engineer-in-chief at Ottawa. The latter minutely investigated every drawing with the assistance of his first lieutenant, deducing the advantages and disadvantages of each respective route submitted.

The chief engineer had given each surveyor explicit printed instructions to keep within grades of 1 in 250 against eastbound, and 1 in 200 against westbound, traffic. The maximum curvature allowed was 4 degrees, or a radius of 1433 feet. If the surveyor found it impossible to keep within these limits, he indicated the fact plainly. In some instances the topography of the country was adverse to the official requirements in point of curvature, but an alternative was suggested here and there with a curve of 955 feet radius. The chief engineer alone had the power to decide any departures from the standards laid down. These, however, were reduced to the very smallest number, and it is only here and there that they are encountered.

From the alternative four, eight, or twelve first locations the chief at Ottawa made his ultimate selection, being guided in his judgment by the report of the chief surveyor of the district in question, who indicated what, in his judgment, was the best location, and whose opinion, seeing that he was on the spot, was generally respected. But before giving his final decision, the chief surveyor of the district was changed, and his suggested best location was handed over to another man to improve if he could. When the latter had completed his task, the amended location was given to a third man or possibly returned to the original surveyor for further improvement. In this way not only was the best route available secured, but a healthy rivalry and determination to excel stimulated the men. Many a young surveyor plodding steadily along with his daily task suddenly found himself thrust into a responsible position, and called upon to attempt to improve the work of a far more experienced surveyor.

If he acquitted himself well on the task promotion was his certain reward.

But the work was hard, and it told upon more than one young fellow, whose spirit was willing, but whose constitution was not hardened sufficiently to withstand the rigours of the northern climate and arduous working in the field, perhaps in ten feet of snow, and with the thermometer at 40 below zero. Winter brought no cessation of duty, no interruption in the work. In one instance the party had a very trying time. They were engaged in getting over a range where the snow fell to a depth of six feet, but would not harden. The result was that they had to wade through the mass up to their waists, and under such conditions advance was slow and highly fatiguing, while snow-blindness or frost-bite was a very probable return for intrepidity. In this case the thermometer decided to descend to an unprecedented level while plotting was in hand by notching 45 and nearly 55 degrees below zero.

The greatest difficulties arose when it became necessary to strike camp and move to another fixed point. The party had to turn out with axes, and hack and cleave a road through the dense wood to gain their next centre, the goods and chattels being transported in sleighs and toboggans which they had to fashion themselves. Nothing short of a blizzard brought work to a stop, and even then, if there were any possibilities of achieving something, the men were out from early morning to late at night.

On the western section, especially between Lakes Abitibi, Nipigon, and Winnipeg, the work proved particularly exhausting, for this is probably the most tumbled and broken stretch of country in the whole Dominion, the mountains notwithstanding. In the winter the cold is intense, while during the early summer, owing to the excess of water, advance is extremely arduous and

dangerous. One district party wrestled with bristling Nature continuously for month after month, meeting an acute problem in the form of huge muskeg—stretches of decayed vegetable matter, saturated with water, strongly reminiscent of a peat bog. On the surface they appear stable enough, but when one ventures on they gently subside beneath the feet like a soddened sponge. The surveyor was informed that it was only from 4 to 6 feet in depth, but when he came to close investigation he found that soundings could be carried to a depth of 38 feet without giving any signs of the bottom being reached.

For some sixteen months without a break they endeavoured to overcome this bad stretch of country, and at the end of that period the members of the party, suffering from the ill-effects of their prolonged seclusion in the wilds, were compelled to return to civilisation. Trouble was expected in this territory, for the Grand Trunk Pacific Railway resolved to profit from the experience of the building of the Canadian Pacific. The latter blundered into the Julius muskeg, which proved to be a galling obstacle. Thousands of tons of rock were dumped into this swamp, but it appeared to be insatiable, and the final cost of overcoming the difficulty rendered this stretch of railway among the most expensive of the whole system to build.

When the task was first put in hand young surveyors saw the golden opportunity to win their spurs with the transit and level in the consummation of this great undertaking. The adventure and romance incidental to work in an unknown country spurred them on. They were enrolled and sent up-country ; but they met with hardships they never expected. They had to assist in cutting their way through the forest, and toiling afoot for 60 to 100 miles, and blazing the trail as one goes is heart-rending work. Many, despite the fact that they had signed

FREIGHTING IN SUPPLIES DURING THE WINTER

When the snow settled on the ground bustle was to be seen on every hand among the construction camps. Huge supplies of provisions and constructional materials were sent forward by sleighs, and in some instances traction engines, locomotives, trucks, and steam shovels were transported by this method.

contracts carrying them to the completion of the work, never reached their sphere of occupation at all, but turned back when they realised what the character of the conditions were.

Others, who reached their parties, refused to perform duties outside their particular province, and inasmuch as in such an undertaking one and all must contribute towards the comfort and well-being of the colony, such malcontents proved an undesirable element, and had to be discharged. Still others, who indeed were willing and skilful at their tasks, proved physically incapable of withstanding the privations, and had to be invalided back. The loss of a man to a party was a serious factor, apart from the cost of replacing him, which entailed an outlay of from $15 to $20—£3 to £4—for transportation through the backwoods, because its efficiency became depreciated. No party was hampered by a single unit more than was absolutely imperative, and consequently, when a man fell out more work was thrown upon those remaining, and this condition of affairs had to be suffered for several weeks, since it occupied anything from a month upwards to send another man in.

Furthermore, many excellent men had to be dispensed with, since, though no reflection could be cast upon their skill, they were found to be unsuited to running the line through such country with sufficient rapidity. The standard of efficiency demanded among the surveyors was extremely high. It was a striking illustration of the survival of the fittest. As a result of this experience, in the course of a few months a rigid test of applicants was held before they were accepted, while all weaklings were weeded out under medical inspection. In this manner the whole of the parties buried in the Rough Country became composed of men having a first-class physique, and who were willing, energetic, and agreeable, so that a spirit of *bonne camaraderie* prevailed, which assisted

very appreciably towards the rapid and successful culmination of the task.

Upon the selection of the route, the projected path was pegged out for the guidance of the constructional engineers, the stakes being spaced 100 feet apart in the centre of the pathway, 100 feet wide where the track was to be laid, with a bench mark indicating the particular level at that point, placed at regular intervals of 1000 feet. On a railway of this magnitude, however, final location is never settled definitely, as it were, before it is constructed. A flying revising party is working always a short distance ahead of the constructional engineers, in the hope that at the very last moment a still better location may be found.

CHAPTER IV

HOW THE SURVEYORS WERE TENDED IN THE WILDS

SEEING that the safety and welfare of nearly a thousand men buried in the depths of the pitiless wilderness, extending over some 1800 miles, rested in the hands of the engineer-in-chief, the gravity of his responsibility may be conceived. But they had been sent to do his bidding, and it was his duty to see that they were made as comfortable as circumstances would permit; that they did not want for a single thing. To keep such a scattered army at the high-water mark of efficiency, to secure an adequacy of provisions, and to keep it in touch with the commanding officer, demanded a remarkable organisation. This was conceived, elaborated, and maintained entirely through the efforts of Mr. Hugh Lumsden, and it constituted one of the most outstanding features of the whole undertaking. It was a supreme task; the perfection of comprehensive, intricate machinery built up of a thousand different links, none of which could be permitted to go awry, lest it throw the whole fabric into confusion. From his office in Ottawa the lines of communication spread out over the country to the most remote and inaccessible corners of the provinces like a huge net, and at all times he had absolute control over every thread. The need of a man here, medical attention somewhere else, provisions there, and instruments in yet another part—all demands were made known to him within the very shortest possible time, bearing in mind

the vehicles of communication available, and were met without the slightest delay. It was mainly owing to the complete character of this organisation and the unremitting vigilance displayed by the controlling force, that the casualty list in connection with the surveying of the Grand Trunk Pacific Railway was so insignificant.

The supreme factor was in regard to the commissariat. Provisions had to be sent up-country at all costs, because the region in which the surveying colonies were buried possessed no subsistence beyond what might be taken from the rivers and the forests, and such fare becomes monotonous in a very short time. The men who knew the country, and who could read the trails through the silent, inscrutable forest were few and far between. The Indians, trappers, and intrepid voyageurs of the Hudson's Bay were those who were most familiar with them, and they were pressed freely into service. The men under the Hudson's Bay banner were most valuable owing to their dexterity and skill in packing goods for transportation by primitive up-country methods, while the Indians and half-breeds were found to be unrivalled in carrying goods on their backs when other means of transport were unavailable or impossible, and for service in the forest.

In the first place roads were driven in all directions leading from large centres attainable by railway or steamboat. These were not highways as we know them, but merely rough paths about two or three feet in width, sufficiently broad to permit of the safe passage of a dog-sleigh and team. At strategical points along these roads depots, or, as they are called in the vernacular, " caches," were established. Some were approachable by water, in which case the supplies were hurried forward during the short summer season when the inland waterways were open, because such transport was far more economical, ranging around $2\frac{1}{2}$ cents, or $1\frac{1}{4}$d., per pound, whereas

land conveyance could not be effected much more cheaply than 7 to 9 cents, or 3½d. to 4½d., per pound.

The main caches were placed in charge of a keeper and an assistant, who for $40, or £8, apiece per month, including living, attended to the receipt of the goods, their safe storage, and trans-shipment to other points, as occasion demanded. From these main depots lines were driven in all directions, along which subsidiary caches were established, the majority without an attendant in the usual frontier manner, the only precautions necessary being sufficiently strong protection of the goods within against the ravages of bears and other animals of the forest. These subsidiary caches were situated at intervals of about eight or ten miles along the lines of communication, and it was from these that the survey parties replenished their supplies as occasion demanded.

Transportation by pack-horse or mule, despite its advantages, could not be practised very extensively, though seeing that each of these animals can carry from 200 to 300 pounds, it is advantageous if possible. But the country traversed could not offer any support to such life. The only remedy against such a natural deficiency was to transport fodder into the territory at frequent points. But as such would have been at the expense of provisions for the parties of men at work, it was not considered feasible. Then again, it has to be borne in mind that the existence of the muskeg militated against the utilisation of horses. Even under the best conditions they cannot make rapid progress—about 2½ miles per hour is a good travelling speed, as I found from experience—and they become stalled very easily in the swampy ground.

Shallow-draft steamers were used on the waterways to penetrate the interior, proceeding so far as navigation would permit in the requisite direction. Canoes were pressed into service also, and for this purpose a large

fleet of several hundred of these craft was procured and commissioned at various points. They were of all descriptions, varying from 16 to 22 feet in length, and comprising both birch-bark, dug-outs, and collapsible canvas vessels. With the larger types a ton of goods could be carried comfortably. But their manipulation demanded men expert in the wielding of the paddle, who knew how to shoot rapids, and who were skilled in the art of packing. Half-breeds and Indians were found to be the most fitted to this work, and they commanded a salary of $40, or £8, per month on the average.

Canoeing is the most exhausting system of transportation in such a country that it is possible to undertake. It is not merely a question of making one's way up or down the waterway with an eagle eye alert for rapids, snags, and other lurking dangers, while rushing along at a furious pace on the bosom of an 8 or 10-mile-an-hour current, nor poling foot by foot up-stream, nor hauling the end of a thin line to get through a foaming mill-race, though that is hard enough work in all conscience, but it is the portaging that takes it out of the canoemen, and sends the weakling to the wall. The canoe has gained a point, say, on such and such a river beyond which it is either impossible or inadvisable to proceed. But just over the hill, or a hundred yards or more through the forest, there is another river, running in the same direction but gaining a point nearer one's destination. This has to be taken. The backwoods canoe is not amphibious yet, so the boat and its contents have to be carried piecemeal across the intervening neck of dry land.

The canoeman unloads his craft on the bank, and by means of a sling over his back becomes a beast of burden, carrying the load in 1-cwt. consignments across the portage. If he has a ton of goods aboard, and is accompanied by an assistant, ten journeys will have to be made, the goods being stacked on the bank of the

"On the Portage"

The most exhausting phase of surveying in a new country such as unknown Ontario and Quebec is the conveyance of goods, chattels, and boats across country. The man straps the load of about one hundredweight to his back, while the canoes are handled similarly, giving the porter the appearance of wearing a huge cowl.

Laying Three Miles of Metals Per Day

In this illustration the track-layer is seen from the front, and is shown in the act of lowering a length of rail, which the men have grasped and are guiding in its descent.

second waterway. They then return to haul the boat out of the water, and turning it upside-down, heave it on to their shoulders, and thread the woods as if garbed in a capacious monk's hood. Like Diogenes, they carry their home with them, the latter not being a barrel, but a heavy 22-foot canoe. Transferred to its element once more, the canoe has to be repacked and retrimmed, possibly to be submitted to another portage in the course of an hour or so.

It is the portage which occupies so much time, and which, from its very nature, subjects vehicle and contents to considerable unavoidable rough usage. A portage may be only 100 feet; on the other hand it may be a mile or more, and carrying load after load across the rough country causes extreme exhaustion, as I found to my cost.

Seeing that 50 per cent of the area of the province of Ontario is represented by water, extensive portaging was requisite to reach certain up-country points. Thus in the Lake Nipigon district provisions and supplies were unloaded at Grasset, the nearest railway station, and sent into the backwoods by canoe. In one case, before the cache was gained sixteen portages were necessary, representing a total overland journey of $10\frac{3}{4}$ miles. In another instance in the same territory sixteen portages had to be made, representing 8 miles; in a third case twenty-nine portages, amounting to 11 miles, were requisite. Some idea of the heartrending character of the canoeman's work may be thus imagined, and when the route lies over such a waterway as the Pic River, on which sixteen portages alone were necessary, owing to expanses of such rough water being encountered as to be impassable without imperilling the safety or condition of the goods, it becomes a superhuman task indeed, and progress even under the very best conditions is bound to be slow.

Portaging was found to enhance the cost of transport

to a supreme degree, and in many instances the charges under this head represented from double to treble the value of the goods being handled. But such disadvantages were incidental to the opening up of a new country, and cost was of secondary importance when human lives were at stake. The greatest trouble in this direction was experienced probably in the Gatineau River district, where as many as fifty portages had to be made on one through journey alone. In such a case as this the damage which the canoes received when passing overland on the shoulders of the packers was so extensive that they survived only a single journey.

Portaging played more havoc with the craft than the dangers lurking in the rivers, although these were of a peculiar nature, and irritating in their frequency. The canoeist had to keep a sharp look-out and to maintain a steady command over his nerves to keep his frail bark out of peril. Even then, under the most expert oarsmanship, a smash now and again varied the monotony of the daily round of toil. Such were of grave significance, for it meant the loss or damage of so much valuable provisions, while now and again the disaster was enhanced in gravity by the loss of a valuable life. When the work was commenced the loss in canoes and lives assumed an alarming proportion, but as the calamities were due to lack of experience or skill, they were avoided by utilising the services of expert navigators exclusively.

But while the rivers and waterways were scenes of unwonted life and activity during the summer, the forests meanwhile remaining practically dumb, during the winter the position was reversed. The waterways froze into a more or less solid mass and were deserted, but the bush re-echoed the yelps of the dogs straining and pulling at their heavily-laden sleighs, mingled with the fearsome gutturals of an Indian half-breed in charge of the train, or the savage ejaculation of a brawny French Canadian.

While the ground was in the grip of the frost the bulk of the supplies were sent in. The snows packed hard, and the flimsy little vehicles were able to speed over its glistening surface. The toboggans were about eight feet in length by some fourteen inches in width, fashioned for the most part from maple, ash, or birch, woods which are the strongest and the most suitable for the purpose, as they combine strength with lightness, and are capable of withstanding considerable rough usage and hard knocks.

The dogs employed were those known as "huskies," powerful, active brutes, possessed of great stamina, wonderfully strong, and strikingly intelligent when once broken into the work. These animals were recruited from the Indian camps, villages, and fur-trading outposts, for they constitute the ship of the snow-bound bush, and no outlying settlement would think of neglecting to maintain a number of dogs for winter use. The dog-team numbered from two to six animals, according to the character of the country on its run and the load to be handled. When the going was hard six dogs were pressed into service, but when it was simple two animals sufficed. The sleigh-load also varied accordingly, but the latter was calculated as a rule on the average of 100 pounds per animal, so that a sleigh of six dogs transported about a quarter of a ton.

Scores of these trains were pressed into service, and they were stationed at various points to transfer the provisions from the main to the auxiliary caches and among the survey camps. During the summer the dogs were placed in the hands of responsible keepers, and carefully tended so as to be in fine condition for their arduous work when winter settled on the land. When in good condition, and when the travelling was excellent, such as through open, level country, or over the frozen, snow-covered lake surfaces, they made from 20 to 40

miles a day, but where the country was broken and the timber dense, the pace dropped to anything between 3 and 8 miles per day. Taken on the whole, however, a train could be relied upon to cover the round journey between two adjacent caches in the course of a day—a matter of 16 to 20 miles—so that supplies were sent forward at the rate of about 500 pounds per train per day.

When the winter settled down and the snows had become sufficiently deep and hard for the dogs to be brought out, the first outgoing team was preceded by a gang of men on snow-shoes who defined the trail, clearing away all branches and dead-fall that may have dropped across the almost indistinguishable narrow causeway. The dog-train trail was also driven in as straight a line as possible, sharp turns being avoided as well as steep climbs, so as to facilitate the rapid movement of the team.

One man generally sufficed for the driving of the train, and, armed with a long whip, he kept his charges at a steady forward movement. Once a train had settled down to its stride, the dogs kept it up, and if provided with a good leader, held to the centre of the trail. But the efficiency of a train depended largely upon the demeanour of the driver. The dogs resent harsh treatment, and at times will strain the patience of the driver to breaking-point. The men must be active, as hardy as their charges, and maintain an equable temper. For the most part these animals have a wolfish temper, which can be roused easily, and should the man lack tact in handling them, he is likely to precipitate a desperate situation.

One French Canadian, who had dog-trained supplies through some of the roughest parts of the country, related to me how on one occasion his team played every imaginable trick when they were first brought under his charge. Moreover, they were the most ferocious and wicked brutes

he had ever handled. It was the first day out. He was lining up the dogs in the morning to harness them, when they broke into rebellion, and in a combined movement made a rush at him. He clubbed the first-comer with his rifle, and then set about the others with his whip. Standing with his back to the wall of the shack, he laid out right and left with his murderous thong as the enraged animals sprang at him. For some minutes the battle raged furiously, the yells of the dogs as the lash of the whip got home being furious. Then it suddenly dawned upon the brutes that they had met their master, and they unanimously drew off and lay down panting. For some minutes he stood still, watching developments, before, whip in hand, he approached the nearest dog, who happened to be the leader. It gave a savage snarl, but showed no further fight, so was harnessed quickly. Then it sprang to its feet and waited to take up its position in the team. The other animals sullenly followed suit, and the train set out as if nothing had happened, though somewhat delayed. The driver informed me that never after did he experience the slightest trouble with that dog train, and never more had to have recourse to his whip beyond the customary cracking to spurt them into effort.

But the driver's life was one of galling monotony and loneliness when out on the trail. A young English fellow who had been in the service of the Hudson Bay Company, but who was experienced in this peculiar work, and knew the rough, wild country well, related his daily round to me. As it is typical, it is worth relating, though it was far more picturesque and romantic when narrated to me round the camp fire in the heart of the silent forest.

He had to pass over a dog road and ordinary trail 350 miles in length. It was a tiring, difficult stretch, through heavily timbered country, where the dead-fall was exasperating, and the country maddeningly uneven,

so that, time after time, the speed of the train slowed up to a mere walk. With the train fully loaded he could make about 17 miles per day. At places where the trail was the most execrable he considered 8 miles a good day's work, while, when the going was conducive to speed, possibly 20 to 25 miles could be made.

He set out in the murky morn from the base and pushed on as hard as he could, for the " Bush Inn " had to be made that night, come what might. This hostel comprised a log shack divided in two, one half being for the driver and the other for his dogs. He had to keep going all the while to gain it before darkness fell. When the elements were kind and the snow was in good condition, he could make the journey before the short winter's day drew to a close. Clad in thick woollens and furs, with his head enveloped, leaving only his face exposed, he sped off on snow-shoes behind the sled. When toiling uphill he would give his team assistance by pushing the load from the rear, while in making descents he prevented the weight crowding on the heels of the animals by hauling back with all his might to a rear line, digging his feet deeply into the snow to secure a steadying purchase. At places the descent was so abrupt that he snubbed the rope round a tree-stump to hold the sled in check as it hurried down the declivity.

But it was when the blizzard raged, and the soft snow gave no grip to the feet, that the true perils and privations of the trail became revealed with a startling suddenness. The sled became clogged, and strain as they might the dogs could hardly haul it along. By pushing and prising he contrived to keep the dogs moving, for once a dog-train comes to a stop the animals are likely to create trouble. Then advance was merely a matter of a few hundred yards an hour, and at places where the white fleecy mass had drifted the train would come almost to a standstill. The dogs dropped down panting vigorously

under the exertion. Cajoled and lashed into forward movement, they would strain the harness to breaking-point in their endeavours to get way on the unwieldy mass. The driving snow almost blinded the driver, and at times he could not see his leading animal, who was completely shut out from his sight by the wreathing and circling flakes. Occasionally there would be an ominous scraping and jarring or wicked lurch as the ungainly vehicle rolled over some obstruction, or it would give a sudden right-angled turn as it collided with, and glanced off, an unobserved tree. Under such conditions the night would be far advanced by the time he gained his destination, and in the glare of the Northern Lights he would unharness his dogs, give them their supper, kindle his fire, and refresh the inner man with a hastily prepared meal. Then banking up his fire, he would roll himself into his blanket and sink into a profound slumber, thoroughly worn out by the day's work.

Up early the next morning, he prepared his breakfast, tended his dogs, and finally, before pushing on, chopped a sufficiency of firewood to meet the requirements of his companion with another train following in his footsteps. It was important that the man departing from a cache in the morning should give attention to this detail, inasmuch as the chances were a hundred to one that the next arrival would come in well-nigh played out. It was but a kindly act to reduce his labours upon arrival, after a day's exacting toil on the trail, to the minimum, so as to enable him to get a well-earned meal in the shortest space of time.

This was the round day after day for three dreary weeks, until the destination was gained. Then he would turn round, and the sleigh now being empty, the homeward run could be made in shorter time, usually in about a fortnight. The whole time the young fellow was out he would not see a soul unless he happened to come upon

the members of a survey party, or spent a night with a companion outward bound. It is not surprising that great difficulty was experienced in securing men who had the hardihood to face a life of this description, combined with necessary experience in handling dogs and packing for a wage averaging about $40, or £8, per month.

The health of the parties in the camps was another cause of anxiety. Accidents were the contingencies to be most feared, for the pure, bracing air and outdoor life contributed toward the maintenance of a clean bill of health, while the observance of the rudiments of hygiene sufficed to ward off the ravages of contagious diseases. Each party was provided with a well-stocked medicine-chest with which the little ills to which flesh is heir might be treated. Still it was thought advisable to hold a fully qualified young doctor in reserve at convenient points, to watch the health of those in the most remote districts. These medical men were given an extensive stock of medicine as well as an excellent selection of surgical instruments and facilities for the performance of any operation that might become necessary. Each doctor was allotted a certain area containing so many parties, and he toured from one to the other, thereby keeping the health of all to a fine point of perfection. His round was a lengthy one, in some cases aggregating 100 or 200 miles, while the continual movement of the parties rendered his task somewhat more irksome. Their provision was a wise precaution, for here and there a slight outbreak of typhoid or scurvy due to limited diet overtook a camp, while now and again a member of the little colony fell a victim to some malady beyond the limits of the camp medicine-chest, such as appendicitis, meningitis, and so forth. The doctor's aid was of incalculable importance in the event of a mishap with an axe, and in the case of snow-blindness and frost-bite.

Life in these vagrant settlements was somewhat

monotonous, far removed as they were from the bounds of civilisation, but their isolation was dispelled somewhat by the inauguration of a mail service. The postman had rounds of perhaps 200 miles or thereabouts; his load was restricted to a maximum of 200 pounds, and in some places three weeks were occupied on delivery. Collection was made at a camp at the same time as delivery, so that the mail service ranged from once a week to once a month, according to the situation of the party. Letter mail only was carried in order to reduce the bulk of the postman's bag, all book and parcel-post matter being sent forward as the opportunity occurred by other means. The postman received and surrendered his consignments of letters at a certain centre, whence they were transported to and from civilisation by the transport parties moving to and fro. It appears a somewhat haphazard method to our more enlightened eyes, but never a letter was lost unless a canoe went to the bottom of a river with the whole of its load. The postman had to make his round as best he could, seizing any conveyance that might be going in the desired direction, if such were available—and that was but rarely. More often than not he was compelled to make his arduous way afoot, whereby, under the most advantageous conditions, he would cover some twenty or more miles a day.

Despite the great difficulty experienced in sending huge stores of supplies into such an inaccessible, broken, and wild country, the caches were kept stocked with supplies sufficient to last some six or nine months, and the men in the field had no cause for complaint in regard to their rations, either in point of variety or quantity. While pork and beans, oatmeal flour and bacon may be considered the staple diet of the bush, delicacies in the form of dried fruits such as apples, prunes, apricots, sugar, condensed milk, tea, coffee, butter, and lime-juice were not denied them. The variation and character

of the menu was dependent in no small measure upon the skill of the cook, and consequently no effort was spared to secure the best man available in this department at a salary of $60, or £12, per month inclusive. A party of eighteen men were allowed some 2617 pounds of supplies, comprising twenty-four different articles, per month, which averaged 5·40 pounds per day per man. The deficiency most felt was possibly in regard to fresh meat, but inasmuch as the forests teemed with fur and feather, while the streams abounded with fish of all descriptions, this drawback could be remedied to a certain extent by the men themselves in their spare moments with but little exertion. The food-stuffs shipped in were of the finest quality, for the authorities realised that an army which could not quarrel with its commissariat was certain to give good working results.

CHAPTER V

THE HEROES OF THE WILDERNESS

WHEN the Epic of the railway is written, the men who laid the foundations of the National Trans-Continental will loom prominently therein. I met several of those who had been associated with the plotting of the line during my journey along the location which the great steelway is to follow to the Pacific Coast. They were not communicative; hardship, privation, peril, and sensational excitement had been encountered so frequently that they considered such as part of the daily round, and now that they could view them from afar, and a more distant date, they made light of them. But when I probed beneath the surface, as seated round the blazing fire in the lonely camp in the wilderness I drew them into conversation, and once more threw them back into the days when they were up in the forest toiling mighty hard to find that four-tenths of 1 per cent grade, they grew slightly reminiscent. And what stories they could tell! What thrills they could give!

Although they talk but little, more than one can show scars of wicked wounds received in that conflict with Nature, in which a great victory has been won in the interests of peace. A missing limb, deformed or absent fingers, blanks on the feet—all tell their own silent stories. They are insignificant injuries incurred in rolling back the map, it is true, but they bear mute testimony to the severity of the battle, the bitter struggle against frost and cold, for those blanks where fingers and toes formerly

existed were caused by frost-bite while toiling with the transit, level, rod, or chain when the glass registered something between 20 and 40 below zero.

The cemeteries around Ottawa, and at a dozen other places up and down the country, can give still more grim and tragic evidence of this fight. The brief epitaphs relate how those beneath the soil met their end in some unfortunate manner while searching for the easy grade. Even the woods mourn over some hero who is sleeping the long sleep beneath a rough mound, carefully railed in with a picket fence and marked with a rude wooden cross. If one searches the pay-rolls one will find here and there the record of a man who set out bravely into the woods never more to be seen or heard of again. The forests and the rivers guard their secrets tightly. The wonder is that the roll-call does not show more unanswered names. It is a striking tribute to the wonderful organisation that was evolved to ensure the safety of a large, scattered army locked in the wilderness.

Every day some daring deed was accomplished; every hour could relate some display of sacrifice; every mile of the line commemorates the heroism of a score of rough-and-ready boys of the bush. There was Walter Leamy. His story is one of sad and heroic self-sacrifice. He was in charge of a transport party, and had a large bulk of supplies which it was imperative should be got through. He was working on one of the most difficult sections at the time, and the winter was one of terrible severity. The party were painfully making their arduous way forward through soft snow and a blinding blizzard. At last they ran into a bad stretch of snow, which compelled a halt for deliberation. The question was what was to be done, as the position was precarious. One of the men volunteered to push ahead to reconnoitre, but Leamy, being the officer-in-charge, refused to entertain the proposal. It was his duty to pilot the party through, and

if any risks were to be run, it was his place to incur them. So he started off, promising to return without delay the moment he found a practical solution of the difficulty.

But the rest of the party waited in vain. The hours slipped by without bringing any signs of the transport officer's return. The worst was feared, so the party thereupon moved forward warily. Their leader's tracks were plainly visible in the snow, and they dogged them step by step. In due course they came to the edge of the narrows of Opasatica Lake, and the imprints went still onward over its ice-bound surface. But the boldest among the party did not like the outlook. That lake was covered with slush, and this is far more treacherous than quicksand. The cause of the leader's non-return was revealed as plainly as an open book. He had pushed on speedily, had gained the edge of the lake, and without pausing, had ventured on its dangerous surface. The ice had collapsed under his weight, and the icy shell had closed over him.

The men of the forest had reconstructed the tragedy only too vividly. When the ice broke the lake gave up the body of the heroic transport officer, and it now lies sleeping in the cemetery of Hull, within sight of the office whence he received his commission.

The slush on the lakes was one of the greatest obstacles which those in the field were doomed to face. From the bank it looks safe enough, but to venture upon its surface is to court certain death. Why ? It is very simple to explain. The lakes freeze up under the advance of winter, but before the encrustation has assumed a sufficient thickness there is a heavy fall of snow. Under the weight of the white, fleecy mantle the ice slowly and steadily sinks below the level of the water, which, pouring over the mirror-like armour, saturates the snow. Under successive falls of snow the ice sinks lower and lower, and the slush assumes a greater and greater thickness,

until at last it measures from 4 to 6 or 10 feet in depth. What is more, it persistently refuses to freeze. The appearance of its smooth surface tempts the daring to advance. It withstands his weight until he has ventured a fair distance from the shore; then, without the slightest warning, suddenly it opens up, drawing the unwary into its icy depths, where he is soon suffocated. One cannot escape from its embrace, no matter how great the struggle, and when the end is reached the slush gathers over one, giving no inkling of the ghastly secret beneath.

In some cases the depth of slush became so deep as to render a lake absolutely impassable. Then the transport had no alternative but to make its way painfully round the treacherous expanse or to improvise a temporary cache upon its bank, delaying the forward movement of the supplies until a more favourable opportunity later in the winter, or possibly during the succeeding spring.

Many have laughed over the "Cremation of Sam McGee," as limned by Robert W. Service, and have admired the verse-writer for the fertility of his imagination. But up on the Trans-Continental some of the boys related a grim story to me which recalled the desperate, uncanny position in which Sam McGee's unfortunate partner found himself. Two men were engaged in the transport service. One of them was stricken down by illness and succumbed. His companion was compelled to carry the corpse back to civilisation for burial. He shrank from the toil through the snow-bound forests with such a load, but it had to be done. A rude coffin was made, and in this the frozen body of the unfortunate chum was laid, the sleigh being converted into a hearse for the homeward run, as it had nothing else to carry. When the man regained civilisation he was scarcely recognisable. They said he had been scared nearly out of his wits and was half demented. It is difficult to conceive the strain on the mind of a superstitious backwoodsman

who was forced through such an ordeal as this, and his thoughts as he made his lonely journey through the silent, snow-girt forest with his grim load; how he must have been startled by the dismal howl of the timber wolves hanging invisibly on his flanks in the cavernous gloom of the trees! After he came in he rambled for hours about his dead chum, and the way they had conversed, sung, and prayed together on that homeward jaunt.

The isolation palled upon some spirits, dragging them down to the depths of despair. The loneliness of the backwoods is one that can be felt, and will soon hurry any but those accustomed to solitary communings with Nature to their doom. One axeman attached to a survey party up in the most inaccessible part of Northern Ontario —this territory has claimed more victims than any other between Winnipeg and Moncton—was missed from his camp. He had gone no one knew whither, but his comrades hurriedly organised a search party and scoured the woods for miles around, making the silent forest re-echo with their frantic halloes. But not a trace of him was found. The forest held its secret as tightly as the tomb, which indeed it became for that poor fellow, for not a sign of him has been seen from that day to this.

During the reconnaissance and the driving of the preliminary lines, owing to the camp being constantly on the move, flitting from point to point, the transportation of supplies resolved itself into a pretty problem. In addition to the subsidiary caches, trains had to be reserved to follow the parties from point to point, since their stay in one spot might be merely a matter of a few days, or perhaps weeks, according to the nature of the surrounding country and the extent of the requisite survey work. One young surveyor related how the party to which he was attached were forced into desperate straits several times, and on one occasion

were within an ace of death from starvation. They were out in the snow, plodding forward steadily, and were so engrossed in their work that they had neglected to observe the distance they had travelled. When they pitched camp one night they found their position to be somewhat critical. There was nothing in the larder but a little flour. From this a kind of paste was prepared and baked—" slap-bang " is the vernacular for this unappetising substitute for bread. They endeavoured to satisfy their cravings on this, and succeeded just about as well as if they had dined off hard-tack. Certainly it possessed no claims to nutritive value—it merely served to fill a void. But there was no alternative.

The next morning " slap-bang " formed the breakfast menu exclusively, and it was decided to retrace their footsteps somewhat, with a view to intercepting the pack-train which was following them and was to the rear somewhere. The little party started off light-heartedly through the blinding snow, and with the thermometer well below zero, for they expected to meet the train in the course of a few hours—certainly before nightfall. But the day wore on without bringing any signs of succour, and the lack of stamina to be derived from their " water-biscuit " soon began to tell its tale. They shivered round the camp fire that night as they ate the remaining crumbs of their sole article of diet, and went to bed in their blankets with an awful gnawing at their vitals. Sleep was well-nigh impossible, and it was a heavy-eyed, weary, and worn-out party that stumbled to their feet and once more set out on the dreary stumble through the interminable snow.

They trudged along slowly and laboriously for mile after mile, but no sign of the pack-train was encountered, and the question arose as to whether they had passed it on their backward journey. For two days they had to tolerate this condition of affairs, and their situation was

rendered more pitiful by a terrific blizzard which broke over them. They could not even succeed in obtaining the slightest sustenance from the forest, for fur and feather appeared to keep well beyond their reach. Then the weakest ones commenced to fall out. Sheer exhaustion caused them to reel along as if in a dream, then they tottered, and finally fell, with an unconquerable desire to sleep. But the stronger ones fought the battle of the weaker against this insidious snow malady, and it was a grim, tiring conflict too, because the victims were so afflicted that they could not help themselves.

In this manner they gained the point where the pack-train should have been had it waited for their return; but though the snow was scoured on all sides for its tracks, none were to be found. The awful fact dawned upon the party that somehow or other the pack-train had failed to come up. There was nothing for it but to struggle on as best they could. Exposure and hunger were telling their tale severely, and their pace was not sufficiently rapid to keep their impoverished blood in circulation. They hesitated to lie down to sleep at night, in case the soporific effect of the white mantle should drive them into unconsciousness, so they huddled together, a shivering, silent mass of humanity, around the camp fire.

They were reeling along in the afternoon. Hardship had well-nigh dulled all their senses. They were dead-beat from hunger and loss of sleep. Suddenly they heard voices raised in vituperation echoing along the trail. It was the pack-train. It gave them new life, and in a last effort they spurted forward. Through the blinding snow they descried the phantom figures of the pack-drivers hurrying forward at the fastest pace possible under the circumstances. The survey party absolutely blundered into the pack-train in desperation; more than one famished fellow dropped down into the snow,

utterly played out. The packers grasped the situation, and while one hurriedly saw to the preparation of a fire and a steaming dish of pork and beans, the others tended to the worn-out members of the party. My friend admitted that it was the narrowest escape he had way up in Ontario.

When the meal had been swallowed, sparingly and with caution, after four days without food, the played-out members were made snug, and permitted to enjoy the soundest sleep they had wooed for a week. It was learned afterwards that the pack-train had been overwhelmed by the blizzard, had lost the trail, and had to call a halt until the weather moderated sufficiently to enable the packers to pick up their bearings. But they met the party just in the nick of time, and my friend had a grim memory of the escapade, for he lost four toes in the starving retreat through the wilds.

But, taken on the whole, though movement during winter bristled with dangers, the summer was the most to be dreaded. Then the foaming waterways, over which a considerable volume of traffic had to be maintained, claimed many a victim. When the work was commenced the number of men anxious to work in this inhospitable country, with its atmosphere of excitement and adventure, was amazing. Their sole recommendation for the task was that they were expert canoemen, because they, in their own words, spent every available moment upon the water in the vicinity of their homes. They were taken into service, only to realise very quickly the fact that canoeing on the comparatively still lakes to the south, and on the St. Lawrence, in the neighbourhood of cities, was vastly different from water-dogging on the unknown rushing rivers up-country. Many a novice in these waters met an untimely end as he came tumbling through a rapid. Consequently the authorities decided only to make avail of men familiar with life in the back-

woods. Thereby not only would there be a saving in the deplorable expenditure of human life, but, more to the point, the item " loss of provisions in transit " would be decreased.

Yet now and again an expert hand with the paddle met his Waterloo. Swamping in a rapid or striking against a submerged rock was the most common cause of disaster, and these overwhelmed both engineers and packers. Up in Quebec the engineer in charge of a sub-district, and his right-hand assistant with the transit, were carrying out their work on the Upper Ottawa River, which is one of the most notoriously wicked waterways in the country. They got caught in the rapids, their frail bark was tossed like a straw from side to side, to come to an end by capsizing, throwing the occupants into a maelstrom, from which there was no hope of escape. Six days later their bodies were recovered and sent to their respective homes for burial.

A French Canadian, Joseph Desroches, attached to another party as axeman, who was an expert water-dog, was poling up the Gatineau, that is forcing his craft up-stream against the current by punting, which is the only means of making headway against the turbulent, downward rush. He was standing in the bow cautiously feeling his way through the rapids. Suddenly there was a cant, the next moment the canoe was upside-down, and the unfortunate axeman was engaged in a forlorn struggle for his life. Those rapids held their victim for over three weeks, and when at last his body was recovered, it was buried reverently on the bank near the scene of the disaster. One can see his grave to-day overlooking the treacherous waters which hurried him to his doom, for a primitive wooden cross erected by his comrades commemorates his memory, and incidentally draws attention to the lurking perils of the waters hurrying by.

And so the list might be continued. Sometimes the unfortunate men aboard the frail craft, by some extremely lucky stroke of fate, were able to scramble ashore, but that was seldom. It was merely the skill of the men engaged in the work, their great respect for the scurrying, swirling waters, and the determination to incur no unnecessary risks, that kept the death-roll so short. Here and there the casualty list glitters with a more than ordinarily exciting accident. There was George Lecours, a canoeman on the transport service around Lake Abitibi. Two canoes were coming down-stream, and in their descent the Buck Deer Rapids had to be threaded. The boats were running in Indian file, the transport foreman, S. F. McGrath, being in the leading craft, while the one behind contained Lecours and Mustard, a companion.

Good progress was being made, and the Rapids were all but traversed when, for some inexplicable reason, the second canoe swung round broadside and crashed into a projecting bleached carcase of a tree which had been caught by the river and tossed on one side, to form a serious obstacle to travel. The force of the collision stove in the frail canoe. Lecours made a spring and landed on the log, while his luckless companion was thrown into the water. The stentorian shouts of Lecours attracted the attention of McGrath, who, grasping Mustard's desperate plight, ran into the bank and hurried to his assistance, Lecours appearing to be safe for the time being. With great effort Mustard was hauled ashore, but when McGrath looked round for Lecours he had vanished. The treacherous log upon which he had taken refuge had collapsed under his weight, throwing him into the turmoil of the raging waters, and he was nowhere to be seen. Diligent search was made for the body, but the lateness of the season prevented its recovery, and so the relentless ice and snow settled down upon the scene of the tragedy and walled in the unlucky canoeman's grave.

BUSH FIRE SWEEPING THROUGH THE WOODS

This. the "terror of the forests," when fanned by a strong wind advances with terrific speed, flaming tree tops being broken off and sent flying through the air, and thus starting another conflagration. The fires are caused generally by careless trappers and travellers omitting to extinguish their camp fires thoroughly.

But the greatest summer peril was from bush fires, which rage with terrific fury and are of frequent occurrence throughout New Ontario, the spruce, jack-pine, and other indigenous resinous trees providing excellent fuel for the flames. The danger from this terror of the forest was not so much in regard to human life, as to the destruction of precious provisions hauled in and cached for the succeeding winter, the loss of which might have jeopardised the welfare of a whole survey party. Once this devastating fiend secures a firm grip it roars viciously. The forest through which it sweeps with incredible speed becomes a fiendish furnace, which either has to burn itself out, or to suffer extinction by a tropical downpour of rain.

Some of the caches were destroyed in this manner, those without an attendant along the lines radiating from a main cache being the worst sufferers. Seeing that these contained anything up to five tons of provisions, their loss was serious. On one occasion, in the vicinity of Lake Abitibi the flames practically encircled a large main cache, and the keeper, together with his assistant, were in somewhat desperate straits. They fought the flames as well as they could for two days incessantly, and made heroic efforts to save the stores, which appeared to be doomed. Fortunately a transport party happened to be in the vicinity of the cache, and they extended valuable assistance, while the news being sent through to the engineer-in-charge of the district survey, not far distant, he abandoned his work in the field, and gathering his party together, hurried to the cache, where the small army fought the flames with superhuman energy.

This fire proved one of exceptional severity and extent, and although the main cache was saved from destruction, a subsidiary cache which was in the centre of the fire zone, and which could not be approached in time to rescue the contents, was lost. Another party which was busily at work in this selfsame area was reduced to a more

unenviable position. They were at work when they suddenly found themselves in danger of being surrounded by the flames. They had no time to strike their camp, but had to abandon everything, even their instruments, in order to beat a mad retreat. Their escape was so narrow that they only just succeeded in getting out of the grip of the fiend, but they lost all their personal belongings, entire outfit, and whole supply of provisions in the stampede.

More than once when out in the field the surveyors found themselves in the path of an advancing roaring bush fire, and were smoked out of the forest like bees from a hive. Under such circumstances, after making certain that their camp and caches were safe, they simply had to sit down and watch the devastating flames sweep by, when they were able to resume operations upon the burnt-out, blackened country. The snow may bring dangers untold, the rushing rivers may prove terrible death-traps, but the forest fire is the greatest peril to be feared, and when it assumes huge proportions, stretching perhaps in an unbroken line for miles, advancing at tremendous speed under the fanning of the wind, then those in its path must discard everything impeding their free movement, and hurry at breakneck speed to a spot well beyond the reach of the insatiable and implacable enemy.

Such was the way in which the path for the National Trans-Continental—the Government division of the Grand Trunk Pacific Railway—was plotted. Its success constitutes a striking monument to British engineering skill, for all those engaged in the task were British subjects, the majority being Canadians. Reputations were made and marred on that supreme effort to find the four-tenths of 1 per cent grade. Certainly it offered a golden opportunity for the young man at the bottom to make his way to the top of his profession through sheer merit in a very brief interval of time.

CHAPTER VI

THE DISCOVERY OF THE "CLAY BELT," A WONDERFUL NEW AGRICULTURAL COUNTRY IN NORTHERN ONTARIO, AND THE PORCUPINE GOLD FIELDS

WE have pointed out already that the surveying engineer, in addition to finding the most economical route for the required line, had to report upon the resources of the country traversed : to draw attention to any wealth lying dormant, whether it were forestal, mineralogical, agricultural, or of any other kind. The prophets said that the country would yield nothing but lumber or pulpwood ; the possibility of it being economical in any other direction was ridiculed to scorn.

Yet what happened ? Scarcely had the surveyors set their feet firmly in the country when news leaked out that a wonderful discovery had been made, so startling in its character as to give every indication of changing the history of Eastern Canada. The evidences of the fact were so palpable that the reconnoitring engineers, although merely speeding lightly and rapidly through the territory, could not help observing its existence. Then the Government almost apologised for the apparent slowness with which the survey through the northern country was being made, and drew attention to the formidable obstacles that had to be overcome. But those behind the scenes knew only too well that some factor was responsible for the delay ; that when the real situation became known the whole of Canada would be startled. The procrastination was intentional. The engineers did not wish to create an empty sensation. After they had stumbled

across the discovery they probed it thoroughly, ascertained its area, and made an intimate investigation of its possibilities before committing themselves to hard and fast facts.

Suddenly the truth flashed out. A wonderful stretch of the finest agricultural land it was possible to imagine had been found, metaphorically speaking, within a stone's-throw of James Bay, the huge indent on the southern shore of Hudson's Bay. It was hidden beneath the pall of the dense green branches of the tangled trees; was fenced off from the world at large by the barrier forming the "Height of Land," running roughly transversely across the province and approximately parallel with the St. Lawrence River. Those who had proclaimed that the Grand Trunk Pacific Railway would never earn a cent between Winnipeg and Quebec, owing to its extreme northern location, found themselves hopelessly confounded, and when they attempted to explain away their hostility were met with derision. Canada is truly the land of great surprises, but few ever have sent such a vibration through the country as the discovery of the "Clay Belt" of New Ontario.

When I made my northward run into this remote country from Toronto the existence of this hitherto unknown stretch of agricultural land was the sole topic of conversation among my fellow-travellers in the train. The silver mines of Cobalt certainly compelled discussion as we passed through Silverado, but it was insignificant in comparison with the fascinating stories of the future of the land "Farther North." My companions represented nearly every nationality. There were stolid Germans, brawny Irishmen, grim, determined Englishmen, powerfully constituted Scotsmen, hardened Galicians, furrow-eyed Italians, fierce-looking Russians, and fair-complexioned Scandinavians, all bent upon wooing Fortune. Whither were they going? To the "Clay Belt." First they were going to start work on the building of

the Trans-Continental, and then, when they had amassed a little money, were going to homestead 160 or more acres in this new land of promise.

Six months on the railway and six months on the land : that was their creed. We passed through clearings in the dense forest where a few German agriculturists had settled, and already were engaged busily clearing away the vegetation to let the genial rays of the summer sun strike the ground upon which it had not focussed its invigorating influence for a century or so. On all sides the woods were smouldering and smoking, showing the energy of the men who had entered into possession.

Yet the prospect was sufficient to frighten all but those determined to succeed at all costs in the endeavour to make money. I wandered from point to point, and conversed with these rugged characters who are laying the foundations of what is destined to become a prosperous corner of Canada. They all admitted that the work was hard ; that it was heart-breaking at first. Also that the outlook was every whit as bad as it looked, and that unless a man possessed considerable grit, he had better prevent his feet turning towards New Ontario.

As to the outlook being fearsome, I can fully testify. To reclaim the wonderfully fertile soil lying concealed beneath those trees appeared about as promising as extracting gold from sea-water. The trees were jammed together so closely that one could not squeeze between them. They were so tangled that although one cut clean through a trunk, it did not fall, but remained upright, held in position by its branches being woven like intricate netting with the branches of its surrounding fellows. Then the undergrowth was so dank, tall, and thick that it resisted all advance. To make progress one had to hack and hew foot by foot with the axe, and so hard was the wood, so desperate was the resistance offered by Nature, that the keen edge of the implement was turned

within a very short time. Unless possessed of almost illimitable brawn and muscle, one could not hope to force one's way through that northern jungle.

However, when I gained an area that had been cleared the picture was totally and contrastingly different. Fire had been driven through the tangled, matted trees. The flames had devoured the interwoven branches, and in some cases had gnawed their way through the trunks. The homesteader had then sallied out through his holding and had lopped the blackened, stark stumps to the ground, had hauled them into a huge pyre, and had fired the whole mass. When that was accomplished a couple of horses, together with a short length of chain and a fearsome-looking, small device, called a "stump-puller," had extracted the roots with more ease than a dentist draws a refractory molar. From half to one acre a day was being cleared in this manner. Here and there the settler had resorted to a more drastic means of accomplishing his end. He had slipped a dynamite cartridge into the base of the trunk, and then, when he had so treated a whole row of gnarled stumps, he had retreated to a safe distance. The press of an electric button, a miniature volcano as a wall of earth flew twenty feet into the air, and the roots lay torn and twisted in a heterogeneous mass on the surface. They were collected speedily and easily into heaps, and fire soon obliterated them.

Then I saw a large stretch of reclaimed bush, and its appearance was a fitting reward to the industry and grim determination of its owner. A dull chocolate surface was exposed to the air and sun. A skilled eye could detect that here was some of the finest soil for which a farmer could wish. It would grow anything, and that without the expenditure of a single cent upon fertilising agents. Nature had endowed the land with all the nourishment it required for the propagation of a variety of crops, for the top-soil was nothing but a thick layer of decayed

vegetation—leaves, branches, and thick trunks which had bowed to the blast or the ravages of time, and had disappeared into dust. This decomposed matter mingling with the gritty constituents of the soil beneath, under the action of the water, had formed an aggregate in which roots could flourish with amazing productivity. I saw some striking evidences of its potentialities in the form of Swede turnips turning the scale at 15 and 16 pounds apiece, carrots 28 inches long, massive heads of celery with large, solid, juicy sticks as white as ivory, free from the slightest blemish, fine potatoes, and huge, hard-hearted cabbages.

Even those who discovered this country are amazed at what has taken, and is still taking place. They were somewhat guarded in their reports, since they did not wish to raise false hopes, did not aspire to lure bold pioneers into the wilds, and then let Nature take a sweet revenge upon them for their temerity by breaking their spirits and crushing their pluck upon the rack of adversity.

Such is the land which rolls away in gentle undulations for 400 miles from the Harricanaw River in the province of Quebec on the east, to the Missanabie River in the province of Ontario on the west. At either extremity the belt is about 70 miles wide, while in the centre it is about 200 miles across. An average width of 100 miles may be considered a safe computation, and this gives an area of 25,600,000 acres. Allowing for occasional appearances of rock, the arable area approximates 15,000,000 acres of the finest and most fertile soil. It is an Empire within an Empire, for it is entirely self-supporting. Agriculture is admitted to be the foundation and the backbone of stability of any prosperous country, and New Ontario possesses facilities for the man on the land to the utmost degree, while the presence of coal, gold, and other minerals of commerce enhances its economic value : imparts a far rosier future than appears at first sight.

Is the outlook promising financially? These frontier settlers vehemently maintained that it was. The virgin land they were taking over at 50 cents—2s.—an acre more than doubled in value from the moment they entered into occupation and felled the first trees. They were prepared to face three years of hard, unremitting toil, for the prize to be won was certainly attractive. One settler I met, and who had cleared four out of his 160 acres, had refused an offer of $4—16s.—an acre all round. In another case a pioneer whose holding was in the embrace of fire had been offered $6—24s.—an acre, and had smiled in scorn. Even $10, or £2, an acre had been held out in some cases. But, no! One and all appeared resolved to hold on. They expected the land to improve two hundred or more times in value during the next three years; they were anticipating confidently the day when they could make $100, or £20, an acre.

Why such optimism? Simply because, apart from the fertility of the soil, the Trans-Continental Railway bisects this rich country from end to end. The discovery of the "Clay Belt" alone has justified the enterprise of those who suggested the new steel backbone to the country. Its development is adequate to secure the success of the line. When a railway can depend for appreciating revenue over a continuous stretch of 400 miles, such as is possible here, thought of failure cannot be entertained for a moment. And when it is recalled that a railway, when pushed to its fullest extremity, cannot serve adequately a strip more than 2½ miles broad on either side, what can be said of a line which is destined to meet the needs of a belt which varies in width from 35 to 100 miles on each hand.

But to describe the country as the "Clay Belt" is a misnomer; is apt to create distrust and to deter the skilled farmer. To talk about clay in his presence is to convey the idea that the land is stiffish, hard to work, cold, and

suited to the cultivation of but a limited few articles in the extensive gamut of agricultural produce. The so-called " Clay Belt " is clay only in regard to its subsoil. The top-soil, that which is the key to the whole situation, is a loam for the most part of a sandy nature. The uppermost layer or superficial strata is a thick growth of moss from 6 to 12 inches in thickness. Then comes a peaty soil extending to a foot and more in depth, with the clay forming a seal to the moisture. But the clay being impervious to water, holds the latter so that a certain amount of drainage is requisite, but this is an easy matter, as surface drains suffice to carry off all superfluous water.

It must be pointed out that only those prepared to face two or three years of the very hardest work should venture into this country. Nature will give many hard knocks ; the settler will require prodigious determination to shake hands with Fortune. This fact was impressed upon me very forcibly by all those who had entered into occupation in this territory. They were having a severely stern, uphill battle, which they anticipated to last for three years or more. But they were spurred on by the reflection that in Southern Ontario, the richest and most prosperous corner of the Dominion to-day, the same conditions prevailed when the Grand Trunk Railway, the first iron road to be laid in the Dominion, was undertaken way back in the 'sixties.

Although the farmer is called upon to undertake heavy clearing before he can bring a foot of his land under the plough, he has the consolation of knowing that the preliminary work is not entirely wasted or futile endeavour. The timber, which comprises black and white spruce, birch, poplar, aspen, Balm of Gilead, balsam, and in some cases elm and cedar, has a certain commercial value. The pulp-wood industry is destined to secure a firm foothold in this country, for the rushing rivers can supply

abundant water-power, and the wail of the world in regard to paper becomes louder and louder every day. As I wandered through the country my eyes were arrested by huge stacks of logs cut to a certain uniform length piled up on every side. Firewood I surmised. But no. The farmers informed me that it was destined for the pulp-mill, and here I realised was an appreciable contributory source of wealth.

And what of the climate? In winter it is cold—extremely so. In summer it is just the reverse. The sun blazes from a cloudless sky for day after day continuously, and its steadily increasing warmth spurs the crops to maturity. In June, at eight o'clock in the morning, the temperature stood at 70 degrees, and at midday the mercury rose to 90 degrees and more. The little colony at the Hudson's Bay outpost on Abitibi Lake relate that for years past they have grown their potatoes in the little clearing around the fort, and have seldom experienced failure, as well as other vegetable produce, including barley. Even ground fruits can be grown with a success that is astonishing. At Monteith, 455 miles north of Toronto, the Provincial Government has cleared an extensive expanse of the cold, gaunt forest for an experimental farm, where the settlers may learn just what can and what cannot be grown with success.

The country is already assuming the appearance of prosperity and hustle. If recent maps are consulted, the name of Cochrane looms up largely in the midst of this vast wilderness. Yet two and a half years ago Cochrane did not exist. To-day it is a thriving community; at the time of my arrival it was in the throes of development.

Its creation arose in this wise. The steelway was planned to run across the country from Quebec to Winnipeg. It was imperative that a short, convenient connection with the

Grand Trunk Railway system in Southern Ontario should be provided. The obvious course at that time was to extend the Provincial Government railway of Ontario—The Temiskaming and Northern Ontario Line—northwards. In this way the main artery flowing from east to west would be tapped, giving an outlet to Toronto, 500 miles to the south, and Montreal, as well as Chicago and the great industrial centres and ports of the United States, since the Grand Trunk Pacific Railway will become the obvious highway between the United States and its remote dependency Alaska. This was accomplished, and at the point where the two lines met, at right angles a huge clearing was made in the forest and the foundations of the town of Cochrane were laid.

This town will blossom into the Clapham Junction of the north, for it is at the Cross-Roads of Canada. Already it gives every sign of becoming such. Within eighteen months it rose from a dot in the wilds to a teeming small town of 1500 inhabitants. Once the trees were cleared, the streets indicated by wide swathes running at right angles to one another, a rush and land boom set in. The prices of lots 50 feet wide by 150 feet deep, fringing the main streets, soared to high figures. Corner plots rose to, and changed hands at, $2000—£400—apiece. Timber buildings sprang up on every side. Before wooden dwellings had become established the conversion to permanent masonry began by the erection of an imposing bank. Two hotels were ready, while stores, shops, and other commercial buildings were doing business on every hand. There was not a foot of gas in the place, except what the residents generated themselves on the spot, and yet electric lighting and power were being discussed. The streets existed in name only. The side-walks, in order to overcome the possibility of breaking one's legs while walking in the dark, and to facilitate rapid movement, were paved

with wooden planks, while the roads were just as Nature had left the surface of the ground, with the tree trunks projecting from 6 to 18 inches above and obstructing vehicular progress.

But the arrangement of the town had commenced. The grading of the streets was under way. The stumps were being grubbed up, piled in unsightly heaps in the centre of the thoroughfare, and then set on fire. A score or more of these pyres were blazing furiously night and day, sending showers of sparks and heavy clouds of smoke into the air. After dark it was as if the whole place were in the embrace of a conflagration. In one of the main streets a timber dwelling had been raised hurriedly to serve as a theatre, and a cinematograph display was being given every evening, the exterior being illuminated as brilliantly as the conditions permitted by an arch of variously coloured oil-gas lamps.

Large buildings were in course of construction to meet the requirements of the railway in regard to the accommodation of engines and rolling-stock. Fifteen miles of sidings were being laid down, and a spacious and imposing junction station was forcing itself into the air. Eighteen months before, if one desired to gain the spot where Cochrane now stands, he had to be prepared to face an arduous and dangerous journey on the back of a pack-horse which would have occupied from a fortnight to a month to accomplish. Yet at the time of my visit a first-class train, with Pullman cars, ran into the station once a day, and departed the next morning. Such is the manner in which this town has forged ahead, and what its future will be no one is bold enough to say. The residents with whom I conversed were discussing glibly the date when they would be able to lay down an electric tramway service, possess telephonic facilities and other little conveniences. And this in a town that was less than two years old!

Cochrane received a decided impetus from the discovery of gold a few miles to the south-east. Some hardy prospectors were sufficiently audacious to face a bitter fight with the locked-up country to embark upon an expedition to search for the yellow metal. Their intrepidity was rewarded. News leaked through to the south, and a mad stampede ensued. The Porcupine Gold Fields were the focus of public attention, interest, and curiosity. In the new sensation Cobalt, with its wealth of silver, was forgotten. Many of those diligently searching for veins of the white metal around Silverado, more to the south, abandoned their quest, hurried up-country, and, notwithstanding the forbidding character of the trek of 36 miles through the wilderness, plunged bravely into the bush. It was a continuous seething stream of humanity which detrained from the railway and scuttled into the forest to wrestle with muskeg and dead-fall, to ford tumultuous, wide streams, and to toil over broken, rock-strewn hill-sides.

A large number of these hardy prospectors accompanied me northwards in the train. Clad in their khaki-coloured canvas, with slouch hat, high, thick-soled boots, with a tin mug strapped to their belt, and their gunny-sack crammed to bursting-point with gold-pan, pick, axe, and other impedimenta, they left the railway at Kelso, the railway point nearest the gold fields. Even this station was in embryo. There was no platform, not a building to indicate its whereabouts, nothing but a small board nailed to a decapitated tree trunk with the name inscribed thereon in white letters upon a black background. A magnificent station replete with various buildings will rise there some day, but its time is not yet. Scattered alongside the railway line were a number of odd-shaped tents, and a host of swarthy pioneers swarmed round the train as it came to a standstill to greet the newcomers. These formed the nucleus of a small town, the

base from which Porcupine was reached. Goods, chattels, and provisions were stacked up in the open air in assorted heaps, and protected from the elements by a piece of canvas or sacking thrown over the top. The Government was in occupation constructing a waggon road through the forest, to ease the arduousness of the overland journey somewhat. Since then, however, the Provincial Government has built a railway which is to be electrically operated, so that the Porcupine Gold Camp has enjoyed but a brief existence as a frontier mining settlement.

The stories that filtered through the country regarding the " strikes " made in this new Eldorado were sufficient to infuse energy into the most lethargic. The wonderful silver discoveries at Cobalt sank into insignificance beside the rich " finds " that had been made in the heart of Ontario's great forest. Scattered over the country in a large circle were hosts of these gold-seekers, diligently examining the ground for signs of veins, and they were meeting with widespread success. A town at Porcupine about 40 miles from the railway was projected at that time, and frontier town-builders were forcing their way across country to carry out this phase of operations, to lay out streets, to erect stores, and to complete the arrangements to meet a thousand and one exigencies.

Engineers were busy up and down the route of the Trans-Continental collecting data regarding the amount of electric water-power available on the rivers, which aggregates many thousand horse-power, and selecting suitable sites for the establishment of large stations where the forces of the water at present running to waste could be converted into electric energy to supply the multifarious demands for power throughout a district many miles in radius. Another party had forced its way at great hazard for 50 miles to investigate a discovery of coal. Should this prove sufficiently attractive, then the problem of supplying the railway with all its requirements in regard

to fuel, as well as the numerous communities that are certain to arise for miles around, will be solved.

The activity in this country was astonishing. Three years before it was threaded only by the trapper and the Indian. To-day it is a hustling hive; the silence of the forest is broken by the million sounds incidental to civilisation. The wealth of the region shut off so long from the rest of the world is being exploited feverishly. And all this because a new steel highway is being driven through the country. When Southern Ontario was taken in hand by the pioneers for development, it occupied a quarter of a century of heartrending effort to clear the ground and to render it productive. In the north the wilderness, many times more forbidding than was the territory fringing the great lakes, has been rescued from oblivion in two years. Within another five years it will have attained a position of increasing prosperity and complete independence.

The remarkable change wrought upon Eastern Canada has more than justified the far northern location of the Grand Trunk Pacific. What the future will bring forth it is rash to prophesy. The same class of country extends towards the Arctic Circle. The shores of James Bay are but 178 miles distant, as the crow flies, and can be gained from Cochrane by canoe in a matter of eight days. Plucky spirits searching for a holiday associated with a strong element of adventure, and desirous of getting far from the beaten track, as well as securing a taste of frontier life and excitement, are already indulging in such trips to the great inland sea to the north with a skilful Indian or backwoodsman as guide. The time is not far remote when the iron horse will make its way northward too, through a country easy of conquest, and which, from its character, is able to support the band of steel practically for every mile of its extent.

CHAPTER VII

BRINGING UP THE CONSTRUCTIONAL ARMIES AND THE RAILWAY BUILDERS' HEAVY ARTILLERY

WHEN the locating surveyors had completed their task, the line the railway was to follow was indicated by a row of stakes planted 100 feet apart, extending in an unbroken line up hill and down dale, across swamps, over granitic, rocky humps, around lakes and through the forest for over 1800 miles. The track was visible plainly through the bush, for the plotters had cut a narrow avenue through the vegetation, nothing more than a passage about three feet wide. The stakes ran down this attenuated lane, and represented the centre line between the pair of metals, for it is a single track.

But, although the procedure appeared so simple, and the route was indicated to the builders so plainly, the task which confronted them was of no ordinary character. They had to bring up scores of locomotives and trains of ballast trucks, together with miles of portable railways, steam shovels, pile-drivers, grading machines, muskeg-fillers, thousands of tons of supplies, and implements innumerable to enable the building work to be carried forward. And last, but not least, there were the hundreds of men to transport through the wilderness to the desired points from which the project was to be attacked, while their welfare was essential.

At the outset there was only one means of consummating the task, at least so far as the stretch between Quebec and Winnipeg was concerned. This was to

drive the line forward east and west from either end, marshalling the forces at a suitable base at either extremity, laying the track as they proceeded, and thus moving the end of steel forward in instalments of 100 miles or so at a time. To attempt to penetrate the country, so as to establish a central driving-point, appeared impossible, for there was an overland journey of about 150 miles through extremely difficult country confronting the builders. The Temiskaming and Northern Ontario Railway—the Ontario Provincial Government line—was carried only so far as Englehart, 138 miles beyond North Bay. Yet the Trans-Continental line, running at right angles thereto, was over 100 miles beyond as the crow flies.

So far as the route through the lower provinces of New Brunswick and Nova Scotia was concerned, there was no cause for apprehension. Although the line passed through unsettled stretches of country here and there, such locations were never far removed from existing lines of communication, and short lengths of waggon road could be driven easily to connect with the latter at convenient points. But there is a vast difference between cutting a 6-foot swathe through the forest for, say, 20 miles and for 150 miles, especially when it has to be made through country extensively broken up by water, and where the crossing of wide, deep rivers tearing along at fiendish speed and gullies was unavoidable.

By forcing the line through the wilds from Winnipeg and Quebec respectively, the outermost camps, no matter how far inland they might be, would be in constant touch with their bases, and any emergency could be met. The inner and most inaccessible stretches of the country could be traversed in safety by this means, and the lines would meet about the centre thereof, in just the same way as a tunnel driven from either end of a mountain

range meets in the heart of a peak towering thousands of feet above. It was realised that the constructional work would occupy a considerably longer period than if the task were attacked from several points simultaneously, but this was a disadvantage incidental to the undertaking.

The first step was the clearing of the right of way. Bands of men expert with the axe sallied forth into the primeval forest with an abundant supply of tools of this character, equipped with a light camping outfit, inasmuch as they advanced comparatively rapidly. From morning to night the savage plonk-plonk-plonk of the razor-like tool hacking through the tree trunks was heard, followed in a few minutes by a long-drawn-out crash as the severed monarch crashed to the ground. These men had to hew a pathway 100 feet wide through the woods, this being the width required to carry the great steelway for 3556 miles from coast to coast. When viewed from a height, this band through the forest, in many places as straight as an arrow, presents a strange appearance with its edges of knife-cut evenness. As rapidly as the trees were felled and deemed useless for any constructional purpose, they were piled into huge heaps and fired. The advance of the clearers was shown by a trail of smoke and smouldering bonfires like that of an invading army burning and pillaging as it moves through an enemy's country.

Hard on the heels of the clearers came the advance lines of the constructional engineers establishing camps for the navvies, and blazing a waggon road over which steam shovels, graders, and other heavy artillery could be hauled to their respective positions. Narrow-gauge lines were laid down, over which ran diminutive ballast trucks from point to point, while, as the grade advanced over embankment or through cutting, a temporary standard-gauge track for the constructional engineers was forced

forward. It was a crazily built line, each rail undulating in an unpleasant manner, so that the trucks and engines as they passed to and fro appeared to reel heavily from side to side. Hour after hour trains rumbled up and down, bearing consignments of gravel and spoil for fashioning the grade.

In an undertaking of this magnitude, where, although the amount of work to be completed is apparent approximately from the drawings of the surveying engineers, a complete quotation for the construction of a certain length of line is impossible. The chances of running into the unexpected are so overwhelming, and the liability incurred is so heavy, that a lump lock, stock, and barrel sum cannot be quoted—no sane contractor would undertake the risk. So the work is carried out on the yardage basis. The contractor is paid for the amount of earth he has to excavate to form the grade. This factor is determined according to the character of the country in which work is carried out.

For purposes of reckoning the material is defined under three headings. Ordinary soft soil, such as loam, clay, free gravel, and such like, is termed "common," and is paid for at the lowest rate ; large stones and boulders less than one cubic yard, loose rock which cannot be removed by hand, pick, or crowbar, and material which cannot be handled by a 10-inch grading plough hauled by six horses, and which does not demand continuous blasting, is known as "loose rock" ; while when the line has to be torn out literally by gunpowder and dynamite for every foot of the way, it is defined as "rock." The latter commands the highest price, the "loose rock" being a happy medium in rating between the two extremes of "common" and "rock." The two former can be handled by unskilled labour ; the latter requires the services of men expert in the economical handling of explosive agents, and who in drilling and firing a blast

can effect the requisite result with the minimum of useless effort—in other words, will not disintegrate more rock than is absolutely necessary, or, as it is technically known, will reduce the "over-burden" to the minimum.

But the opportunity to attack the undertaking from its most difficult point—the centre—arose. The Ontario Provincial Government, realising the possibility of a remunerative traffic, and that they could provide the Trans-Continental with a short, direct connection with Toronto and the great cities to the south, decided to carry their line, the Temiskaming and Northern Ontario Railway, northwards until it connected with the former. It would involve the building of 114 miles of line through arduous country where extensive bridging and heavy embankment work would be necessary. The authorities, however, with characteristic enterprise, determined to push the line ahead in anticipation of the future, and this prevision has been well repaid.

As this line approached its junction with the Trans-Continental, which is now indicated by the town of Cochrane, the attack on the Grand Trunk Pacific Railway centre commenced. Lake Abitibi was rendered accessible, and that was an appreciably helpful factor. The Temiskaming and Northern Ontario Railway crosses the Black River, which connects with Lake Abitibi, and directly this was achieved a contract for 150 miles of the central section was let and hurried forward. The representatives of the contracting company hastened northwards to the Black River at a point known as McDougall's Chutes. They spied out the country and decided to establish their head-quarters at the above point, to drive waggon roads, and to convert Lake Abitibi, which is 44 miles in length by a maximum width of 18 miles, into a channel of communication.

Boats were brought up over the railway and launched on this sheet of water, while the material for scows was

also transported up-country and erected by the waterside. This gave a decided impetus to construction, since the Trans-Continental skirts the northern shore of the lake. Roads were blazed in all directions to gain strategical points along the right of way, the supplies and material shipped north during the summer going via these roads, while those consigned during the winter were sent forward over others which were more suitable to sleigh transportation. Material was brought up also at great effort for the erection of steamboats on the selfsame lake, and designed to traverse the River Abitibi to the point where the Trans-Continental was planned to cross the waterway, or at the point at which a base camp was to be constituted. This was a daring undertaking, because Abitibi River is beset with dangers to navigation, but it was well worth the attempt, inasmuch as its successful use would enable material to be got into the country quickly.

The particularly dangerous points were three chutes. It was deemed too risky to attempt to rush these with freight on board, so tramways were laid around them. The laden vessels paused at the lower ends of these tramways, the loads were disembarked and sent round overland to the head of the chute, through which the lightened steamer made its way as best it could, and upon arrival reshipped the supplies once more. It appeared to be a roundabout process, with all the attendant evils arising from frequent handling, but it was preferable to jeopardising the safety of a heavy consignment of precious supplies in the chutes.

As soon as Cochrane was reached it became a very busy constructional centre. From this point the line was driven both east and west, the former destined to meet the arm advancing from Quebec, and the latter to link up with the section approaching from Winnipeg. A vast tract of country was cleared to house the various

needs of the railway contractors, and it has proved a useful, valuable base, inasmuch as it is in direct touch with Toronto, about twenty hours' run to the south.

Though the situation in the Lake Abitibi country was eased now very decidedly, that around Lake Nipigon occasioned considerable anxiety for a long time. Indeed, it is a moot point whether the country traversed by the railway north of this sheet of water was not more difficult of penetration than that more to the east. Supplies could be brought by rail and boat to Nipigon, nestling in an indent on Nipigon Bay, a sheltered corner on Lake Superior, but from that point northwards the undertaking was distinctly hazardous. Just north of Nipigon town is Helen Lake, the upper end of which is 18 miles distant from Lake Nipigon.

When the contractors desired to push into the country they set to work building a narrow-gauge railway to connect Lakes Nipigon and Helen. A tug and scow were placed in service on Lake Helen, by which supplies could be conveyed to the northern shore to be transferred to the railway, by which they were moved forward to the southern end of Lake Nipigon. Messrs. Revillon Brothers, the well-known fur-traders, and active competitors of the Hudson's Bay Adventurers, undertook to bring up materials and to build a steam barge—no slight undertaking in itself—by which the material could be shipped from the northern end of the narrow-gauge railway to the head of the lake for distribution wherever desired. Let it be remembered that all these elaborate and expensive preliminary arrangements were essential to enable 75 miles of line to be built!

These preliminaries occupied some seven months, being pushed ahead with all possible speed, as the contractors desired to send forward a heavy consignment of supplies to enable a large army of men to be kept at work on the grade during the winter. They had only

something like a month to achieve their desires, and in that time succeeded in sending up 1500 tons of material of all descriptions before the lakes froze over and navigation had to be abandoned for the winter. The moment the first consignments of supplies reached the head of the lake forces of navvies were hurried up-country, and the grading commenced in grim earnest. However, they could not enroll more than 400 hands for that winter, since the provisions were inadequate. But when the ice opened in the succeeding spring, both men and provisions were sent into the country in a ceaseless, heavy stream.

In addition to the main line running across country to Winnipeg, a branch line was planned from Fort William, on Lake Superior, to run for 189 miles north-westwards, to tap the Trans-Continental 247 miles east of Winnipeg. This was undertaken in order to give the capital of Manitoba an additional, more direct, and easier connection with the water-highway via the Lakes. This line is of strategical importance, as is described later, and will prove to be one of the busiest stretches of railway in the whole of the Dominion.

The camps strung out in a long line along the route of the railway were interconnected by a telephone system, which also brought them into direct touch with the bases of operations. It was a flimsily built line, and its erection offered an interesting introduction to frontier methods. The first man went his way with a good supply of wooden, peg-like brackets, carrying glass insulators. At fairly uniform intervals a post was fashioned hastily from a suitable young tree, and to the top the insulator bracket was nailed. In his wake, following the right-of-way, came a team and vehicle carrying a large coil of wire As it skirted the post the attendant on board deftly threw the wire over the bracket, the line trailing mournfully in deep festoons from post to post. Behind the wire-man came the line-man, who swarmed the post, tightened

the wire, and effected the requisite connection to the insulator. In this way several miles of telephone could be installed during a single day. It represented a certain item of expenditure, but its convenience for communication between various camps when other means would have been unavailable, repaid its cost several times over.

Another preliminary operation was the driving of a waggon road linking the various camps. It was a rude highway, it is true, but a few feet in width and roughly fashioned. Banks had to be eased, and where bad stretches of swamp or muskeg existed these had to be fixed by means of corduroying, i.e. tree trunks laid transversely and nailed to longitudinal side-pieces, so as to afford a stable surface to the passage of vehicles and animals. A ceaseless stream of teams and vehicles passed along this road from morning to night, bearing provisions, constructional material, and other impedimenta for the various camps.

Labour was one supreme difficulty. Recruits could not be enrolled in sufficient numbers to handle and tend the heavy artillery of the railway-builders. Nearly every camp was below strength. It was not that the wages were low, but because of the loud cry for hands that prevailed throughout the whole of the west. The contractors raised the wages with a view to tempting men to the spot, but the farmers were not to be outbidden. Their harvests had to be garnered, by hook or by crook, at high pressure. It was not until the wheat was housed safely in the elevator that the situation became eased.

Faced with the prospect of unemployment during the winter months, the labourers turned their footsteps from the farms to the railway constructional camps, where, so long as they cared to toil, they were certain of a steady 17 and 20 cents—8½d. to 10d. per hour—for the commonest unskilled work, while those expert in the

task commanded wages according to their worth. The result was that more work was accomplished during the winter, when the country was in the grip of frost and snow, than in summer.

The construction of the line was taken in hand in large stretches at a time, ranging in length from 40 to 100 miles or more. At intervals of every two or three miles the constructors established camps for a small army of men, horses, and material, while ample supplies of food were stored to meet their requirements for six or nine months. In addition the section was subdivided into divisions ranging up to 12 miles in length, on which resident engineers were stationed. These engineers were in the Government employ, and the scope of their operations was to report on the progress of the work, how it was being accomplished, together with periodical returns for calculating payments due to contractors as the task proceeded.

Each resident engineer was assisted by a transit-man, rod-man, chain-man, and one or two supernumeraries, who were in the field the whole livelong day, watching and checking operations to preserve the grade and alignment, while the resident patrolled the stretch to ascertain that everything was proceeding smoothly and satisfactorily; that the requirements of the specification were being fulfilled strictly to the letter. No opportunity to scamp the work was afforded, even if there had been any such inclination, for there was the divisional engineer in charge of a certain number of residencies, to check the work of the latter, while the divisional engineer in turn was watched by the assistant engineer, who was a lieutenant of the chief at Ottawa. Still, it is satisfactory to record that no serious friction arose between contractors and the Government engineers, and certainly complaint was never raised as to inferior work. At times disputes as to the classification of the earth handled arose through

differences of opinion, but such were invariably adjusted upon appeal to the engineer-in-chief, and even if this action proved abortive, arbitration settled the difficulty satisfactorily.

Innumerable conveniences were provided to improve the lot of the workmen and to expedite the task in hand. Hospitals were erected at frequent points, ready to handle any class of accident or illness that might overtake any of the men, with fully qualified physicians, and skilled surgeons in charge. Their services were not required to a great extent, beyond attention to accidents, which, despite the rules laid down to prevent the occurrence of mishaps, could not be prevented in their entirety. Fortunately the camps, owing to the hygienic manner in which they were laid out, and the adamant observance of sanitary laws—no easy matter, bearing in mind the nationalities of some of the labourers who had flocked thither from countries where the rudiments of hygiene are not enforced—carried a remarkably clean sheet of health. Now and again there would be a slight outbreak of an epidemic—generally typhoid fever—but such were always caught in the incipient stage by the medical men retained for the contract, and their skill and knowledge soon served to stamp out the visitation.

Then the mail service claimed attention. An excellent organisation for the periodical collection and delivery of letters was elaborated, and although the men were entombed during the winter in an open-air prison, the surrounding wall of wilderness constituting an impenetrable barrier, yet the workmen even in the outermost camps were enabled to keep in touch with the outside world, their relatives, and friends. Now and again they would make a short excursion to civilisation with their accumulated wages. This generally partook of the nature of a first-class carouse, since no intoxicating liquors were obtainable in the constructional area. When the reward

for the sweat of their brow was expended, they returned to the field of their former labours broken in pocket.

To those working on the grade up in New Ontario the journey south was invariably too expensive and lengthy just to satisfy a passing craving, seeing that in some cases they had to travel a matter of 250 or 300 miles. Even Cochrane, though a town of some significance, could not boast a single establishment at which alcoholic liquor could be obtained; Englehart was the nearest licensed community. It is little wonder, therefore, that the saner men, much though they would have enjoyed the opportunity for a "night out," decided that the journey was not worth the gratification of desires. Consequently the larger number of men working in the silent wilderness were enabled to make money, and to invest their wealth in a farm, business, or what not, thereby establishing themselves firmly on the first rung of the ladder leading towards sturdy independence.

When the whole undertaking was brought thoroughly into swing, it produced a scene of hustling activity unparalleled in the history of the world. A solid 1800 miles of main line railway of the highest grade was in the melting-pot. Something like $100,000, or £20,000, were being poured out every day to provide work for over 25,000 men who were engaged in a mighty struggle with rock, muskeg, and forest.

CHAPTER VIII

THE GRIM TUSSLE WITH NATURE

WHEN the 25,000 odd men settled down to their work, when all anxieties taxing the contractors in regard to supplies and provisions for the welfare of the scattered forces had been removed, and a period of nine months' steady work could be faced confidently, when thousands of horses, scores of locomotives, steam-shovels, and what not had got into stride, the grade assumed its definite shape in quick time.

It was no simple conquest. Here and there Herculean efforts on the part of the constructional engineers were demanded such as one scarcely would expect to be requisite outside a mountain range, where the heroic is expected and has to be accomplished. But the rock and muskeg of the rolling country offered as stern a resistance as any mountain hump, and at times well-nigh baffled the most accomplished brains. Every artifice known to the engineers was pressed into service to overcome some especially perplexing difficulty, and when such failed new ideas had to be evolved and be submitted to the test.

On such occasions quiet, hard thinking became imperative. Every man on the particular job in hand was urged to suggest some practical solution and thereby extend a helping hand. Any feasible idea, no matter how ridiculous it appeared at a cursory glance, was attempted. Sometimes it succeeded, in which event the ingenious brains which had helped to extricate the engineers from the quandary were rewarded duly; if it failed to rise

to the occasion it was simply abandoned, and no more was heard about it. Desperate straits demand desperate remedies, and no one knew but that a mere navvy, handling the pick and shovel from morning to night, though with years of experience at his back, might conceive the very means of solving a constructional puzzle.

The swamp occasioned many anxious nights, and much burning of midnight oil. At places it appeared to be bottomless. The ballast locomotive would haul train after train-load of spoil excavated from the ballast pit, and push it cautiously along to the end of the dump, where the trucks would be discharged. The rubble would rush down the declivity, and as it came into contact with the surface of the morass there would be a wicked squelch. Then the bog would open, and slowly, but surely and silently, the discharged mass would disappear into the viscous mass until the last vestige had slipped from sight, and the slime had rolled over the spot, concealing all evidences of the few hundred tons of material emptied on to the spot but a few minutes before. The engineer would sound the bog anxiously for signs of the bottom. Yes, he could feel it all right—10, 15, perhaps 20 feet below the surface. The trains would continue to rattle up and down with heavily laden trucks, and send the contents crashing pell-mell into the swamp below. Ten train-loads of gravel, rock, and what not would disappear from sight, and the engineer would probe the treacherous sponge once more. But the soundings did not vary a foot. Where had the dump gone ? The ballast had sunk simply to the bottom of the bog, and had spread itself out on all sides, finding its own level like water. The bed of the morass was as broken as the hill-side near by, and was intersected in all directions by ruts and gullies. Until these holes were filled there could be no possible hope of the embankment appearing above the surface of the bog.

So the contractors simply had to keep on dumping and dumping for hour after hour, day after day, until the surface of the ridge of ballast at last appeared and remained within sight. Then it was left for a few days, to ascertain whether settlement had ended, and that a good solid foundation had been obtained at last. When all indications pointed that the desired end had been achieved, then that longitudinal ridge grew rapidly to the requisite level. The track was laid down hastily and crudely upon the newly-completed work, and the locomotives pushed the laden trucks a few hundred feet further on.

Thus the advance was made. Sometimes it occupied weeks to progress 100 feet, for the swamp's appetite appeared insatiable. In more cases than one a whole hill had to be removed bodily to fill up a " bad place." In the ballast pit the screeching of steam was heard from morning to night, as the cumbersome steam shovel, in slow, measured strokes, dipped its capacious maw into the bottom of the bank, and with a fearsome scrunching, scraped its huge steel teeth up the face of the cut to secure a good bite of spoil, then swung round and disgorged some three tons of rock, gravel, and clay into the empty trucks standing alongside.

At other places the grade grew as if by magic. The country was possibly almost level, and but the minimum of work was required to build up the solid pathway for the track of steel. Then the grade would follow a line almost as straight and direct as that defined by an arrow in flight, and so gently undulating as to be practically level. For instance, when standing in the centre of the track at Cochrane one can look east and west and not see the slightest sign of a curve. The line disappears over the horizon through the rectangular cleft in the trees which looms up distinctly on the sky-line. To the west it is straight for about 30 miles, while to the east a similar result prevails for almost the same distance.

A factor which militated very appreciably against rapid construction was the large number of rivers and creeks which had to be crossed. The railway running approximately parallel to the range of hills forming the "height of land" cut across the waterways at right angles. Some of these rivers are of respectable width, and the erection of the necessary temporary timber trestling to provide the constructional trains with facilities to cross the obstruction, leaving the bridge-work to be erected later, occupied considerable time. But the men selected for this work were sent on ahead of the graders—in some cases they were some 30 miles distant from the steel—working in a silent isolation, straining every nerve to get the false-work ready by the time the grade, irresistibly forcing its way forward, gained the bank of the river.

At other places a wide depression had to be crossed. The level of the grade was some 20 or 30 feet above the floor of the valley, which, more often than not, was a shallow muskeg, with its surface cracked in all directions, like a mud pond which has dried up in midsummer. Perhaps it was half a mile or so across. Maybe the end of steel was 50 miles to the rear, but the builder estimated that he would reach that depression by such and such a date. To build up the embankment by dumping the spoil from the bank, and thus forcing his way foot by foot across the dip, was too slow.

Consequently a gang of a hundred men or more, with several teams, lengths of chain, and hooks, were dispatched to the scene. One party of men armed with axes attacked the forest, felled the trees, and stripped the trunks of all branches. As fast as they were cleaned they were bound up in small bundles by a chain and a team hauled the mass of poles to the depression. Here another gang took the logs in hand, and in a short time the building of a trestle was under way. Perhaps one tier sufficed—

on the other hand, possibly three were necessary. The uprights for the lower tier were driven into the ground more or less firmly, and the horizontal members were nailed up, with here and there a diagonal to add to the solidity of the structure. The first tier was carried across the dip, and then the party returned to undertake the second, followed perhaps by a third tier. When completed it was a crazy enough structure in all conscience, and just sufficiently wide at the top to take a pair of metals.

By the time the trestling was almost completed, and after, maybe, 10,000 feet of logs had been consumed in the fashioning of the structure, the grade had reached the edge of the dip. The engine pushed the laden ballast train out on to the bending, groaning trestling, which threatened every moment to collapse under the weight, there was the movement of a lever, and the contents of the truck tumbled through the woodwork. Now and again a length of this flimsy woodwork would give way or sink, sending a truck flying off the track to strike the ground 30 feet below with a sickening thud. The mishap to the truck was nothing. It was the condition of the unfortunate navvies who had been carried away with it that occasioned anxiety. If they had rolled clear of the murderous missile which knocked them off their feet everybody laughed or cursed—these railway graders are rough diamonds—but if one had been knocked about and hurt he was picked up and borne off rapidly to the hospital to be patched up. As for the truck itself, it was hauled out, and in a very short time was in service once more.

The embankment grew around the feet of the trestling with great rapidity, and it was not long before all signs of the timber work had disappeared beneath the solid earthen wall. One might think that the decomposition of the timber might imperil the safety of the structure,

but such is not the case. If the wood does rot, the process of decay is so slow that it receives compensation from the periodical overhauling and reballasting of the line, while in the earliest stages it serves to hold the gravel fabric together.

The grading machine is an implement well worthy of watching at work. It may be hauled by a steam traction engine, or be operated by animal power; in either case the result is the same. In general appearance it recalls a wheat-harvester. There is an inclined shoot, over which travels an endless chain of small scoops or buckets such as are used on conveyors. At the bottom, under the centre of the machine, is a sharp edge, acting in the same way as a plough. When the machine is set in motion, the plough tears up the earth and forces the spoil into the buckets as they pass by on the endless chain. They are swung up the inclined plane, and as they round the highest point discharge their contents into a capacious, horse-drawn hopper waggon, which ambles along at the same pace as the grader. When the vehicle is filled it draws to one side to make place for the succeeding empty vehicle, which in its turn drops out when fully loaded. Consequently, as the grader moves up and down over a certain length of grade it is accompanied by two endless streams of vehicles, one of which represents loaded and the other empty waggons. So fast as the vehicles are charged they proceed to the point where the embankment is being raised. They reach the edge of the dump and drive down the declivity. Suddenly there is a whoop, the horses give a sharp swerve, and simultaneously the driver depresses a lever, the bottom of the waggon falls out, and the contents are shot on the dump.

Such a machine obviously can be used only where the soil is soft, i.e. where it coincides with the "common" classification of spoil. But it is a machine which plays sad havoc with the animals, as the work is extremely

exhausting. I have seen as many as twenty horses hitched to a single grader in three rows of four abreast marching in front and hauling the machine, assisted by two rows of four abreast pushing behind. And every animal has to strain itself to the utmost, for ploughing off the brow of, or making a cut through the crest of a mound by this tool is excessively exacting when continued for hour after hour up and down a certain stretch, without the slightest change, and with only a few minutes' rest now and then.

The muskeg-filler is another trying tool for animal effort. In this case the edge of the machine scrapes the surface of the ground, though without forcing the material into conveyor buckets.

But the "sink-holes" were the spots that occasioned the greatest anxiety. A length of embankment had been built; the locomotives passed to and fro with trains of ballast to dump miles ahead. The wall of earth appeared as solid as a masonry structure when work was stopped for the day. Yet the next morning, when the engineers appeared, parts of the embankment had subsided, leaving the rails hanging in graceful festoons in mid-air. The earthen ridge had sunk so many feet during the night. When the grade was built there was no indication that the ground beneath was unstable—everything appeared as solid and substantial as rock.

Some of these settlements assumed grave proportions —the whole line for 100 yards or more was thrown into confusion. This was one of the unexpected factors which the builders were doomed to encounter. Then the engineer had to ponder deeply. The only thing he could do was to keep on dumping until the subsidence ceased, but the great point was to learn the precise depth of the sink-hole, since mere dumping only served to add to the superimposed weight brought to bear upon the treacherous ground. If the sink were not very serious this method

A "Sink" in the Grade

At places, owing to the soft character of the ground, the embankment settled down in a mass for a depth of thirty feet or more. Then the grade had to be built up again on a mattress of tree-logs and branches woven together.

An Exciting Moment at the Clover Bar Bridge

To facilitate communication between the piers and the banks a gangway was laid athwart the river at low water. In the spring the water rises several feet and rushes along tumultuously. This photograph shows the situation just as the river has risen to the level of the gangway and is breaking it up.

would prove successful, but when it affected a great length of line, and amounted to several feet, it assumed a different aspect entirely.

When dumping pure and simple did not solve the problem, an ingenious expedient was adopted, both in regard to sink-holes and swamps which appeared to be capable of swallowing spoil indefinitely. The embankment was built on the corduroy. This is simply a thick mattress formed of tree trunks laid and woven together to form a solid, homogeneous whole, the various layers of logs being disposed in different directions, and all tightly secured together to prevent movement. This mattress was laid down, and the embankment built thereon. Under the weight of the earth the corduroy sank until it compressed the unstable ground beneath to its limit, when the mat rested firmly in position and the embankment could be piled up thereon in absolute safety. There is little danger of this foundation collapsing, inasmuch as it cannot decay—in fact, the probability is that it will increase in strength with the lapse of time, owing to the wood becoming water-logged and forming a dense, hard material similar to bog-oak, which will last and fulfil its purpose to the end of time.

Work was forced ahead during the winter; there was no pause for snow or frost. The men might grow weary of their lonely situation and extreme remoteness from the haunts of civilisation—might long intensely for a night in a saloon, or a few hours in a gambling hell. But they could not get through that terrifying forest resounding with the music of the timber wolves pressed with hunger. The dark trees, held tightly in the grip of frost and snow, were an impenetrable barrier; they hemmed in the small colonies far more securely than prison bars; the grade during the winter was a penitentiary. The men had to work; there was no alternative but to starve and perish.

Now and again restless spirits endeavoured to break their fetters. Port Arthur and Fort William were so alluring to the gangs around Lake Nipigon that they could not resist the desire to run the gauntlet through 100 miles of snow-bound land in the embrace of a cold 60 degrees below freezing-point, and a silence that was maddening. With a cheery farewell a party would leave the camp. The old dogs basking in the warmth of the cook's glowing stove would nod their heads significantly. If the intrepid ne'er-do-wells did not return to camp within a week as emaciated specimens of humanity as you could wish to see, then the merciless frost would hold its secret tightly until the winter broke, and the bleached skeletons would be found lying under a " fly " stretched under the trees. How they died would never be known, but the canine teeth imprints on the bones would suggest only too poignantly the last phase.

Yet at times it became necessary to break through the bonds of snow and ice. One engineer related to me a story which for adventure and sensation scarcely could be equalled. He received orders to make his way to the grade. How he was to get there was a matter for his own ingenuity and courage. He had to take a party in with him. Nipigon town was his starting-point, and there was a dreary, solid 100 miles' toil through the hardest conceivable country confronting them. He collected a dog-team and sleighs, and loaded them up with an ample supply of provisions and other requisites. As they were leaving Nipigon town a sturdy half-breed boy wanted to accompany them. He was young, and the engineer, not wishing to be hampered unduly, refused the proffered assistance, since every additional mouth to feed was a consideration. But the youth was not to be denied. He could show them the way, and might be useful if they got into a tight corner. No more was said, and so the little party plunged boldly into the snow-bound wilds.

They made good progress until the water-broken country was gained. As they were striking their way northward a terrific blizzard broke over them. They did not pause, but pushed on as bravely as possible. The snow fell so thickly that they could not see a yard before them, and the circling flakes threatened them with extinction. The crisp sound beneath their feet betokened the fact that they were making their way over the treacherous slush, so they advanced warily. Suddenly there was an ominous crash, one of the sleighs gave a wicked lurch, and was just disappearing from sight when, by a superhuman tug at the lines by which they were holding the vehicle, the party just saved it from immersion, but not before the majority of them had become soaked to their waists. Their frantic endeavours to save the sleigh, however, broke up the ice in all directions. When they regained the bank they examined their belongings, and, to their utter dismay, found that the transit had slipped off the sleigh in the mishap, and was now lying submerged in the slush. What was to be done? The party were on the horns of a dilemma. To go forward was useless, for the engineer without his transit was as helpless as a millionaire marooned on a rock.

Suddenly the half-breed boy thrust himself to the front. He had come with the party unbidden, and now he would attempt something to justify his presence. He would try to find the transit. He scuttled back to the point where the accident had occurred, the rest of the party following cautiously behind to ascertain what he was going to do. Following the trail, the young half-breed reached the hole, and without more ado plunged into the freezing mass. Seconds passed and he did not reappear. Then there was a commotion, and his matted head shot up from the murky liquid. He had failed, but he emerged just to take a breather. Three times he repeated his dive without success, but on the fourth

attempt, as he emerged from the uninviting water, he was observed to be pulling at something with all his might. A helping hand was stretched out, and it was found that he had recovered the lost transit! The engineer gave a sigh of relief and took the young half-breed under his charge. They gained the forest, pitched camp, and in the heat of the fire the intrepid boy dried his clothes on his frozen frame and looked little the worse for his adventure.

But not so the engineer. The party pushed ahead, but the chief gave signs of being in pain. He had difficulty in breathing; each inhalation shot through his lungs like a knife. He became worse as he proceeded. They gained the grade and the camps, where a little rest and rough frontier care eased him somewhat. But he was far from being well, and at last it was decided that he should return to civilisation for treatment. The half-breed offered to steer him back. The twain set off with the sleigh and dog-team. Though racked with pain, the engineer struggled along. Every night when they pitched the camp the half-breed waited tenderly upon his chief, made him as snug as circumstances would permit, and never left him for an instant, performing every task. The youngster appeared to have a constitution of steel, and to be possessed of tireless energy.

At last, after five days' hard struggling through the backwoods, civilisation was regained, and the engineer, almost on the point of collapse, was hurried to a doctor. A brief diagnosis revealed his illness—it was pleurisy, and the wonder was that he had not succumbed. Under skilled attention he recovered his health completely, and once more set out through the snow and slush to rejoin his companions up-country with the young half-breed as his bosom companion. I met the engineer in the wilds, and his appreciation of that young half-breed knew no bounds. The boy subsequently left them;

whither he went no one knew, but the chief missed his companionship sorely.

While the upper stretches of New Ontario and Quebec were occasioning the engineers many anxious moments, owing to the eccentricities of the muskeg and swamp, the graders advancing eastwards from Winnipeg were in close grips with rock, which offered a most stubborn resistance. For the first 75 miles the going was excellent, as it was the eastern fringe of the great prairie that had to be overcome, but once the invisible line of demarcation between Manitoba and Ontario was crossed, the character of the country changed with startling suddenness. For mile after mile it was a ceaseless boring through rock of the hardest character ; rock which could not be moved or penetrated without the aid of dynamite and gunpowder. Some of the cuts that had to be made through this material were of stupendous proportions, not perhaps so much on account of the height of the wall on either side of the track, as because of its continuous length. When the rocky barrier gained a sufficient height, the cutting of an open rectangular channel was abandoned in favour of a burrow, but tunnelling was reduced to the minimum.

For hour after hour, day after day, month after month, nothing was heard but the chink-chink of drills and the devastating roar of explosive with its splitting and disintegrating work. Advance was exceedingly slow, some of the blasts requiring as much as six weeks or more to prepare, and then only breaking up sufficient of the granite mass to permit of an advance of about 200 feet. Swedes and Italians, from their long experience in rock-working, gloried in this country. Employment was steady and continuous, while, in view of the fact that such work commanded the highest wages, it proved highly attractive to men who are born rock-hogs. Scarcely a day went by without a vicious upheaval, and an ugly wound was

torn in the surface of the ground as a whole mound or hill was sent into the air in fragments.

Some of these blasts were of huge proportions. There was one in particular along the shore of Lake Pelican. A huge cliff barred the advance of the grade, and there was no alternative but to blow it away bodily. Shafts were sunk into, and galleries were driven on all sides at the bottom of, the obstacle. Thè drills toiled incessantly for six months preparing the pockets for the reception of the explosives. Dynamite and black powder to the value of $5000, or £1000, were rammed into the base of the cliff, and the whole was then fired. The shock was terrific, but the "shot" scattered 14,000 cubic yards, or, say, 30,000 tons of rock, of which some 6000 tons were hurled into the lake, and the grade was able to proceed on its way for a further few hundred feet.

It was on work of this nature where the greatest number of accidents occurred, the majority of which might have been avoided had the men engaged in the operations displayed but ordinary care. Dynamite and flying rock were the greatest contributors to the casualty list and death-roll, although the men engaged in the work were among the most expert it was possible to find. But their very dexterity and skill proved their undoing; the fact that their task was beset with more than usual danger served to tempt Fate. "Familiarity breeds contempt" is a well-worn axiom, and when it is associated with such an agent as dynamite, the result invariably is somewhat disastrous to everyone in the vicinity of the spot where the adage is subjected to the test. These men are so accustomed to handling sticks of dynamite that they regard it with the same nonchalance as a navvy does his pick-axe.

True, there is no danger to be feared from this devastating agent so long as it is treated with a certain amount of

BUILDING A WOODEN TRESTLE

The upright members are disposed in rows of five, the outer log on either side being set inwards at a slight angle. The whole are clamped together by iron dogs to secure solidity. The "bent," as it is called, is generally twenty-five feet in height.

THE "STONE-BOAT"

For the removal of the rock as it is blasted out the "stone-boat" is used extensively. It consists of a flat scoop hauled by a team of horses along a rough track consisting of tree-trunks laid on the ground in two parallel lines. The logs are faced roughly flat, and sometimes are greased to facilitate the movement of the curious vehicle.

respect, but it resents strongly the rude treatment meted out by the rough-and-ready rock-hog. This is especially the case in winter. The thermometer dropping down to the sixties freezes the dynamite as readily almost as it congeals water. When the rock-hog finds this to have occurred he merely proceeds to thaw out the dynamite by placing it near the fire! He knows only too well that thereby the explosive is rendered a thousand times more dangerous, that thawing livens the agent extremely and makes it intensely "tender," but that does not matter: it is treated just as unceremoniously as when in the grip of frost. In the course of seven months on this section alone out of a casualty list of 42 killed and 10 wounded, 35 met their deaths and 9 were injured by explosion, 5 other deaths and 1 injury arising from being struck by rock. Dynamite was responsible for more deaths on this undertaking than any other accident—the collapse of the Quebec Bridge notwithstanding—and sickness combined.

Had the authorities not been so watchful the list of killed and wounded would have been far more formidable. It was only by instilling into the minds of the rock-hogs the broad fact that they imperilled more than their individual lives by handling the treacherous stuff as if it were a toy, that accidents were kept well within bounds. The men working in the rock carried their lives in their hands. If they did not respond readily to the signal to "stand clear," they were certain to be overwhelmed.

I saw men time after time retreating but a short distance from the blast, and observed large pieces of rock miss them by inches only. Did they wince? Not by any means; they regarded such missiles with as much contempt as hailstones. The rock-hog lives a haphazard, happy-go-lucky life. He believes in the saying that a piece of jagged rock which misses him by an inch might

just as well have been a mile away, and laughs jarringly when you start at his narrow escape.

Then again, many are so anxious to resume work on the debris after the blast is fired that they do not give a thought to the fact that some shots may have missed, or hung, fire. They only discover the error of their judgment when the missed shot is beaten into life by an unlucky blow from some tool, to spread death and wounds quickly on all sides. These rough men take exceedingly long chances. To them dynamite is but a means to an end—a tool just as much as a pick-axe, which enables them to secure a high price for their work, and to draw a large sum of money when they want to go out.

Ere the grumble and rumble of the blast has died down, and before the plume of smoke has dissipated itself in the sky, the men swarm over the pulverised pile. The rock is broken up into all shapes and sizes. Then the stone-boat is hurried up, and the process of removing the debris to make way for the narrow iron road goes forward merrily.

The stone-boat is a peculiar vehicle incidental to America, and has nothing whatever to do with the water. It resembles a huge metal tray or shovel hauled by a team of horses. And its special path is as novel as the boat itself. It is only two wooden lines fashioned from tree logs adzed roughly flat on the upper side, well greased, and laid promiscuously and roughly parallel on the ground. The stone is prized and levered on to the tray, and hauled with a speed, which, bearing in mind the primitive road, is astonishing, to the dump, where a sharp swing round on the part of the horses pitches the mass down the bank.

But though the rock is hard and it teases the builders to a supreme degree, it has one compensating advantage. It secures a bed for the railway of magnificent solidity.

On the other hand, it means that a certain mileage of unproductive country has to be traversed, where there are no claims to scenic attraction. But there is a possibility that this rocky stretch will yet have its day. Traces of mineral have been found, and should these be present in sufficiently attractive quantities, it is just possible that the exploitation of the country will prove profitable to the mining industry. I heard rumours of some highly promising "strikes," and a mineral rush to the country around Lake Nipigon is by no means remote.

CHAPTER IX

THE QUEBEC BRIDGE, THE LARGEST CANTILEVER STRUCTURE IN THE WORLD

EVERY great railway undertaking possesses some feature of supreme engineering interest which towers far and away above everything else on the system in the eyes of the public. This focus of popular interest in the present case is the colossal bridge which will carry the railway across the St. Lawrence River near the City of Quebec. This busy water avenue of Eastern Canada here rolls between lofty banks on either side, those to the north forming the historic Heights of Abraham. The crossing of the river demanded elaborate and searching investigation, as Quebec, being the premier port on the waterway, had to be brought into touch with both eastern and western seaboards, by means of the new artery of steel. This was no easy matter, inasmuch as the mercantile traffic on the St. Lawrence is considerable, ocean liners, while calling at Quebec, proceeding farther up the river to Montreal, while freight boats penetrate to the Great Lakes.

It was recognised, if bridging were adopted, that the structure would have to be of huge proportions, and that the rails would have to be carried at a great height above the water, to enable the large vessels to pass beneath. Owing to the height of the banks on either side the question of the approaches was comparatively unimportant, since the grade could be secured without any great difficulty. The crossing of the navigable channel constituted the most difficult problem, for at this point the river is over 1200 feet in width.

As such a bridge would represent a far more stupendous

undertaking than any previous effort in this field of engineering, where the "unknown element" would assume more startling proportions, there was a certain reluctance in some quarters to embark upon a record-breaking enterprise. As a result the possibility of tunnelling the river was discussed in all its bearings, but this was found to be quite impracticable at a reasonable expenditure, and so was abandoned. A ferry service of large boats capable of handling a whole train, somewhat similar to those plying across Lake Ontario between Cobourg and Charlotte, was out of the question also, as this means of solving the problem would be inoperative for several months during the year when the waterway was closed with ice.

The upshot of the deliberations was the decision to carry a bridge across the river. The authorities were emboldened to take this step, owing to the success of that engineering feat in connection with the spanning of the Firth of Forth. They reasoned that if a single span of 1710 feet were possible of erection, and could stand the test of time, that a span only a few feet longer should be equally practicable. Consequently a cantilever bridge springing across the river in a single leap of 1800 feet, with a clear space of 150 feet between the rails and high water, was designed.

Certainly it was a magnificent and imposing structure that was contemplated, and the realisation of the scheme was taken in hand by one of the largest and most experienced bridge-building firms in the United States. American engineers ever since the Forth Bridge was completed had been longing for the opportunity to be able to eclipse the Scottish wonder of the world, and consequently this chance of gratifying ambition was seized on with avidity. Everything was planned upon a huge scale. From end to end the bridge was to measure 2800 feet, built up of two approach deck spans 210 feet

in length, leading from either bank. Each of these spans was to lead to a cantilever, the shore arm of which was to be 510 feet in length, while the opposite arm was to reach out over the water for a distance of 562½ feet. When these were erected the space between the two projecting arms was to be filled by a truss span measuring 675 feet from end to end, which in itself would be the longest simple truss span that had ever been built. The piers for supporting the cantilevers were placed as near the water's edge as possible, so as to reduce the obstruction to the river to the minimum, and were built of masonry. From the level of these piers the steel work was to tower upwards to a height of 315 feet, this being the greatest depth of the cantilever, while the least depth of the latter, 97 feet, was at the portals.

Such a structure was to be made to satisfy the demands of the community to the utmost extent, for the problem of affording easy communication between the opposite sides of the river has been one which has perplexed Canadian authorities for years, the ferry service being regarded as incompatible with modern methods. Consequently, in addition to carrying two pairs of railway metals for the heaviest freight locomotives and trains of to-day, there were to be two sets of metals for electric tramways, two thoroughfares for vehicular traffic, and two pavements for pedestrians. The whole were to be placed on the same level, the width of the bridge being 67 feet

By the time this structure was completed it was computed that some 38,500 tons of steel would have been used, at a cost of $3,000,000, or £600,000, while the total cost of the undertaking was estimated to be from $6,000,000 to $7,000,000—from £1,200,000 to £1,400,000. Yet it was agreed that such an expenditure, huge though it was, would have been laid out to conspicuous public advantage, for the benefits from it would be felt throughout the whole of the Dominion. The civic authorities

THE QUEBEC BRIDGE BEFORE THE ACCIDENT

This structure spanning the St. Lawrence was to be the largest cantilever bridge in the world, with a main span of 1800 feet, and the rails 150 feet above the water. Some 800 feet of the main span had been constructed when the whole fabric collapsed.

THE QUEBEC BRIDGE AFTER THE ACCIDENT

About 18,000 tons of steel had been set in position when through the failure of a bottom rib of steel near the pier the whole mass settled upon itself into the river. Seventy-four workmen lost their lives in this calamity. A new bridge is now in course of erection across the river.

of Quebec and the Provincial Government demonstrated their appreciation of the scheme by contributing tangible assistance in the form of subsidies of $300,000, or £60,000, and $250,000, or £50,000, in return for the facilities in trans-river communication, from which they would reap incalculable benefit.

The scheme, once approved, was hurried forward with all possible speed, in the expectancy that it would be completed by the time the new highway from coast to coast was opened. A period of seven years was expected to be occupied in the task. While the preliminary work in regard to the construction of the piers was in progress the steel was collected on the spot, and the approach spans pushed forward. The work was commenced in 1902, and in July, 1905, the main cantilever construction was taken in hand. In the early stages progress was somewhat hampered by the fact that work was only possible for about six months during the year, and in 1906, owing to the severity of the winter, operations were somewhat retarded.

The southern cantilever was taken in hand first, the shore arm being erected upon a massive timber false-work. When this was completed the erection of the arm projecting over the river was commenced. By the aid of the travellers, or large erecting cages, the work was built outwards on the overhang principle, that is to say, the projecting arm was not supported on false-work, but was balanced by the weight of the shore arm. Two travellers were in use, one a small appliance weighing 250 tons, employed for setting the outermost ribs of steel in position, and another massive structure 300 feet in height, and weighing 750 tons, which was used for the erection of the central and highest portion of the cantilever. The latter was completed without accident, and then the smaller traveller was forced forward to build one half of the central simple truss span, whereby the opposite cantilevers were to be connected together.

The skeleton of steel was projecting about 800 feet from the main pier, was within less than 400 feet of the centre of the river, and in all about 1300 feet of the bridge, representing 18,000 tons of steel, had been set in position. The engineers followed the work minutely, making elaborate and detailed records of all deflections and movements of the structure, as the traveller thrust its way farther and farther away from the shore. The strains and stresses set up under these changing conditions, for such a mass of steel is as sensitive as the nervous system of the human body, were calculated continuously.

About the second week in August, 1907, one of the engineers associated with the enterprise observed signs of incipient weakness in one bottom rib of steel near the pier on the shore side. The matter was investigated, and the resident engineer, being perturbed by this eccentricity on the part of the piece of metal, dispatched a colleague post-haste to New York to record the circumstance to the consulting engineer to the enterprise—one of the foremost luminaries in this branch of engineering in the United States—while another was sent to the American works of the bridge-building firm on a similar errand. Construction, however, was continued without a pause until August 29th, 1907.

It was a calm summer's afternoon. The hooter had sounded the call to cease work for the day, and some eighty-five men were descending from their perilous situations in mid-air to gain the shore. At that very moment the constructional engineers were drafting a message to the resident engineer to suspend operations until the cause of the weakness in the failing rib of steel had been investigated by experts who were hurrying north. It was unfortunate that the message was not dispatched earlier, for suddenly the gigantic network of steel, without the slightest warning, tumbled into the river, carrying some eighty-five men with it, of whom only eleven were rescued.

The catastrophe was so sudden that no one for a moment grasped really what had happened. Where a minute before the outline of one half of a handsome bridge was limned against the cloudless sky, was now nothing but a tumbled, torn, and twisted mass of steel debris lying in the river, and pinning down seventy-four men. The accident was astonishing, inasmuch as the whole mass did not topple over to one side, but simply settled down upon itself under its own weight, as if it were a house of cards.

The calamity, so swift and complete, sent a tremor through the whole world, not so much on account of the terrible loss of life which rendered the accident more tragic, but because theories which had been followed tenaciously by bridge-builders were scattered to the four winds. It was admitted that this structure represented the last word in bridge-building and engineering science, and that the design represented the result of three years' incessant labour on the part of the foremost engineers on the continent. Yet all that skill and accumulated knowledge proved of no avail—it was shattered completely within two minutes. Some 18,000 tons of steel and thousands of pounds were lying now at the bottom of the St. Lawrence.

The shock struck the American bridge-builders with greater force than it did their British colleagues in this same branch of engineering. The latter had regarded the design askance ever since it first saw the light, for it was considered to be too light, while American bridge-building design and operations on the whole never had proved attractive to them. When the Forth Bridge was completed a well-known American bridge-engineer remarked that enough steel had been used to build several structures of a like character, but Sir Henry Fowler, Sir Benjamin Baker, and Messrs. Arrol and Sons incurred no risks ; they took no chances, realising that they were

attempting a task of unprecedented magnitude. The Quebec Bridge constituted the latest expression of this work from the American standpoint, and their skill had proved to be sadly wanting. Certainly the Americans have not recovered from the terrible blow that this accident dealt their prestige and prowess, for ever since American methods have been regarded with considerable suspicion, which, however, is not justified entirely.

But the accident, though costly and attended with a lamentable loss of life, bore its fruit. A searching investigation as to the causes of the disaster was made, and many striking deficiencies in the modern knowledge of steel and bridge-designing were brought to light. The financial loss was heavy, especially as in addition to the steel which had been erected, and now was worth no more than junk, the balance of 20,000 tons was in readiness for transportation from the works to the northern bank of the St. Lawrence. This necessarily was thrown back on the builders' hands, as it was useless for its intended purpose.

But the Canadian Government resolved that the St. Lawrence should be spanned by a bridge, if such were humanly possible, though they were determined to run no risk of incurring a repetition of an accident of this nature. A Board of engineers was appointed to discuss and prepare designs for a second bridge. As a result of three years' labour and the expenditure of $250,000, or £50,000, a design was evolved by the joint efforts of the Commission. Bridge-builders were invited from all parts of the world to submit tenders based on the official specifications, and also upon alternative schemes of their own, the Government thus hoping to secure the best product of engineering science. In the official design the length of the cantilever span was reduced from 1800 to 1758 feet. Five companies submitted tenders both on the official and their own individual plans, the number in-

cluding one Canadian, two German, one British, and one United States firms, while no less than thirty-eight different plans were laid before the Commission. After careful consideration, the majority of the Board decided upon the plans of the Canadian company, which differs entirely from the official design, and the work of erection has commenced.

But the new bridge is by no means so ambitious as that first attempted, nor is it so comprehensive as that evolved by the Board. The latter called for two roadways, in addition to the railway tracks, but the former have been suppressed in the accepted design, which virtually becomes a railway bridge purely and simply, there being only a pavement on either side for pedestrian traffic. Moreover, the accepted design does not provide for such a heavy bridge as was arranged, the calculations being based upon the use of a lighter locomotive and train. The outcome of this arrangement is that the requisite amount of steel is reduced very materially with a corresponding reduction in the cost of the structure.

The variations in the tendered prices for the work were very marked, ranging from $16,000,000, or £3,200,000, for a bridge as proposed by the Commission, to $8,650,000, or £1,730,000, for the accepted design. The amount of steel required for the completion of the scheme is reduced very extensively also, for whereas the official specifications would have required about 66,000 tons—almost double the quantity forming the first structure—the accepted design calls for the consumption of 43,750 tons of metal. The length of the span, however, remains the same, namely 1800 feet, while the top of the cantilever will be 310 feet above the top of the pier. Owing to the elimination of the roadways, which reduces the utilitarian value of this connecting link, the subsidies extended by the City and Province of Quebec have been returned,

the Government undertaking sole responsibility for the financial outlay upon the bridge.

It must be pointed out that so far as the Grand Trunk Pacific Railway is concerned no financial responsibility whatever has been incurred. The Dominion undertook the enterprise as a separate and distinct project, the railway not being called upon to contribute a single cent towards its erection. Though through rail traffic from coast to coast via Quebec will be delayed for a few years to come, an alternative route is available. The Grand Trunk Pacific trains will leave the new trans-continental line at Cochrane, to follow the track of the Temiskaming and Northern Ontario line, to North Bay, where junction is effected with the Grand Trunk Railway system, running to Toronto and thence to Montreal. Here the St. Lawrence River is crossed over the Victoria Jubilee Bridge, a famous structure nearly two miles long, and the southern bank of the river is followed to Levis, opposite Quebec. At this point the Grand Trunk Pacific line will be entered again and followed to Moncton. This route always will be of great value, even when the Quebec Bridge is completed, as it brings the west into direct touch with the manufacturing centres of the east. Moreover, it will provide the Grand Trunk Pacific with an alternative route to Halifax and St. John.

However, no time will be wasted in carrying the new structure to completion, and while erection is in progress a ferry service will maintain communication between the opposite ends of the trans-continental railway. There is one point which is forced powerfully to the front as a result of this amended undertaking. It will give a pronounced fillip to Canadian bridge-building enterprise, and the successful conclusion of this work will render the Dominion, with its enormous resources, a powerful competitor to the United States in a further field of engineering endeavour.

CHAPTER X

SPANNING THE PRAIRIE WITH THE BOND OF STEEL

THE construction of the second division of 1756 miles between Winnipeg and the Pacific Coast differed entirely from the building of the section between the capital of Manitoba and the Atlantic sea-board at Moncton. Here the two extremes of conditions in railway engineering have been encountered. First there was the prairie section extending uninterruptedly for 916 miles west of Winnipeg, where the technical difficulties to be overcome were of a trifling nature, and where the work could be carried out very rapidly, followed by a stretch presenting diametrically opposite characteristics—840 miles through heavy mountainous country, involving the penetration of two formidable ranges before the coast was gained.

So far as the first 1000 miles were concerned, the face of the country is for the most part gently undulating, comprising a succession of steppes such as the famous Carberry Plains, divided by low hills, running up to a height of 2500 feet, recalling the sparsely wooded natural sylvan parks of England. On this section the heaviest difficulties involved were in connection with spanning the wide-yawning valleys at the bottom of which noble rivers made their way. In some cases these channels were of tremendous width, with the breadth of the stream out of all proportion to the deep, wide gap it had cut during the flight of centuries, thereby testifying to the remarkable eroding forces of Nature. At times

the bridging of these waterways presented some pretty problems in order to preserve the grade, for the water had carved a channel which offered nothing but a gorge with the banks rising sheer up from the water's edge to a height of 150 or 200 feet.

But little difficulty was experienced in fulfilling the official requirements regarding grade and curvature throughout the whole distance of 916 miles from Winnipeg to Wolf Creek, whence commences the Mountain Division, although the Rockies are about 100 miles beyond ; in this distance there is no gradient against east-bound traffic exceeding 21 feet to the mile. It was found impossible, however, to find an easier grade than 26·4 feet per mile adverse to west-bound trains between Winnipeg and Biggar, a distance of 766·6 miles. What this means to the heavy traffic of the west, when engines are called upon to haul a train of wheat extending for about a third of a mile, may be imagined, and throughout the whole country, as a result of my conversations with the farmers, I learned that the easy grade of the Grand Trunk Pacific was regarded by them as holding the key to the whole future of the north-west.

After leaving Winnipeg the railway runs due west through a thickly populated and settled country for 54·3 miles to Portage-La-Prairie, so called because the *voyageurs* of old, in their northward trek, here left the Assiniboine River to portage across the narrow neck of prairie to gain Lake Manitoba. Very little scope was offered here to run through new territory for some 113 miles, seeing that the proximity of the Manitoba Lake country compels railways and other roads of communication running east and west to keep to the south, and as Winnipeg has become the clearing-house of the Prairie, and commercially the centre of Canada, the various lines are necessarily within easy reach of one another. Portage-La-Prairie is a busy junction ; four main lines and trans-

continental railways run through it—the Grand Trunk Pacific, the Canadian Pacific, the Canadian Northern, and the Great Northern of the United States.

The advance of the sinuous metal snake forming the Grand Trunk Pacific was accompanied by a development which is unique in the annals of railway expansion. So soon as the project was decided definitely, and before the constructional engineers had signed their contracts, a steady stream of settlers poured into the country. They had learned the location of the line, so pushed ahead of construction and settled upon the virgin prairie. Had any unforeseen factor developed to delay the fulfilment of the project, such as a financial panic, or what not, a terrible economic disaster would have been precipitated. These hardy pioneers were not to be denied or dissuaded from their purpose. They had heard about the bounteous, prolific, fertile character of the land which the new line was to traverse, and were fully cognisant of the fact that if they waited until the undertaking was completed and perfect communication was secured, the land would rise to a prohibitive figure, so they burned their boats behind them, and set out bravely for the new land of promise.

By invading the country ahead of the constructional armies, they were in a position to purchase their land at the rock-bottom price. This was their argument, and they lost no time in putting it into execution.

Yet it was a perfectly judicious, logical, and enterprising proceeding. However, the railway did not anticipate the sequel. The rail was pushed forward as fast as was humanly possible, but its advance did not coincide with the rapidity with which the farmers were able to bring the land into bearing. The builders were handicapped by shortage of labour during the summer, for the farms absorbed every man looking for work. The result was that the early farmers found the harvest upon

them with no means of getting their produce to market! What was to be done? The line was in an incomplete condition, so railway transportation appeared absolutely out of the question.

One or two of the hardest-headed farmers put their brains together and attempted to evolve a way out of the difficulty. Could the railway-builders introduce a few freight cars laden with wheat into the accommodation trains? The former came up the grade laden to the utmost with all the materials required for construction, but they had a comparatively empty return journey. By attaching laden grain cars to the backward run, the latter could be made somewhat remunerative. The project was considered by the builders. They did not regard the suggestion with favour, as construction trains, owing to the incomplete character of the permanent way, have unhappy tendencies of running off the metals at times, and although these mishaps played havoc somewhat with the trucks, still they did not hurt them to any great degree. With laden wheat cars, however, it was a different matter. It would not demand a very smart concussion to splinter such a vehicle and to distribute its precious contents of grain over the track. However, the farmers decided to take the risk. Accordingly a strange spectacle, unparalleled in the Far West, was witnessed. An empty construction train, with its strange assortment of sorely battered, decrepit-looking cars, was to be seen making its return journey to the base of supplies with several box-cars laden to the full with grain. It was but an experiment, but it served to extricate the farmers from a precarious situation.

When the labour problem righted itself after the wheat was harvested, and the discharged farm hands flocked to the railway to earn sufficient to carry them through the dreary winter months, the builders crowded on every ounce of pressure to force the railway forward. Yet

this was not always feasible. The prairie may be level and lend itself to rapid construction, but it has its own peculiar drawbacks. In the first place the country could not yield a tree! Every foot of timber had to be hauled from remote points, and by the time it gained the site of construction it represented a heavy outlay. A culvert would be delayed because the temporary wooden baulks had not arrived; the track could not be laid as there were no sleepers available; and so on. When a huge timber trestle to span a river and valley temporarily became necessary, the situation became far more serious. These structures, from the configuration of the country, assumed huge proportions—half a million feet of timber were soon consumed. And they were no mere slips either, but lengthy, bulky, heavy, squared logs felled in the forests of British Columbia, Washington, or some other state on the Pacific Coast, which had to be hauled, maybe, some 3000 miles. No matter how sharp an eye was maintained upon their transit, and despite the expedition of their dispatch, the trains bearing these loads would be delayed in the course of their lengthy journey, while now and again one would meet with accident while threading the great mountain passes. Then again, when the wood had been brought to the constructional base, maybe it was required actually for building purposes about 30 miles ahead of the end of steel, inasmuch as the contracts varied from 100 to 150 miles in length, grading on which was commenced at twenty or thirty points simultaneously, the various points being connected by a waggon road.

When it came to transit by team and waggon to the site of erection the situation assumed a grave aspect. The road was but a track over the prairie. In dry weather it was passable enough, and movement could be made fairly quickly through ten or twelve inches of dust. But when the wet season broke, and that dust was converted

into mud as glutinous as gum, it was a difficult task indeed that confronted the freighters. A load of baulks possibly 30 feet long by 10 inches square was a massive weight to haul through country having the consistency of a bog. The freighters worked on a weight basis—possibly 5 cents, say 2½, per pound, irrespective of distance of haul—and they had a heart-breaking task to make the job financially profitable to themselves. Such a system has its advantages, since the more journeys that could be made in a given time, the more they could earn, but many a weather-worn old freighter confessed to me that it was killing work.

I met them time after time struggling through the rain and slime with their massive loads. They jogged along at a steady pace from early morn to late at night, making no more pauses during the day than were downright necessary. When they met a difficulty in the form of a mud-hole, the hours sped by like magic. Their advance was frantically heroic ! The horses were immersed up to their girths, the axles of the wheels could not be seen for slime, and the men themselves waded waist-high through the morass, adjuring their horses, and endeavouring to extend assistance by shouldering the wheels. On the dry road they could count upon a steady mile or mile and a half an hour, but when they reached a " bad place " 100 feet in the same length of time was good going. I saw one load of timber floundering in the grips of a mud-hole, and the freighters were in a sorry plight. The " bad place " was barely 100 feet across, but when the centre was gained, nothing of the vehicle was to be seen. Only the baulks of timber indicated that something on wheels was underneath. A solid hour and a half had been occupied in going 50 feet forward, and there the vehicle settled down. The horses were played out, and the men were exhausted. The animals were unhitched and pulled, rather than led, from the bog on to dry land to

FREIGHTING THROUGH THE BUSH

Great activity prevails through the country ahead of the railway. All sorts and conditions of vehicles, hauled by oxen, horses, or mules, are pressed into service to transport the thousand and one necessaries for the railway camps.

take a short rest, the men seizing the opportunity for a hasty meal to reinvigorate their expended energies.

By the time they had decided to resume operations another laden vehicle had arrived on their heels. The situation was discussed, and the driver of the second vehicle offered to lend his two horses in return for a similar compliment. Thus four horses and four men essayed the task of extricating the first vehicle. By dint of superhuman pushing and pulling it was forced inch by inch to the other side, but an hour was expended in the ordeal. The second waggon was then taken in hand. It was not laden so heavily, and so an hour sufficed for it to cross the treacherous 100 feet. And this for less than 3d. per pound! The worn, hardened old freighters sighed sadly as they recalled memories of the good old days when they could command a shilling a pound for freight. Then mud-holes did not matter much, but when competition had forced the price down to a miserable 5 cents, why, it wore the flesh off the bone! When I left the spot the respective drivers had taken the wheels off their waggons, were cleaning out the mud, and regreasing the axles in the hope of being able to make up lost time a trifle by facilitating the movement of the vehicle under the influence of lubricant!

At the trestle a scene of great animation was to be seen. Large gangs of men were fashioning the "bents," as the sections are called, securing the members firmly together by heavy iron dogs. Perhaps the valley to be spanned was over half a mile in width, and in the centre so much below the allowed level of the grade as to require no less than five tiers of bents. As each of the latter when erected stood 25 feet in height, this represented a timber structure towering up 125 feet in the centre. To set something like half a million feet of timber into position to form one of these structures to carry the iron road appears an appalling task, when the rift is seen in its nakedness.

But trestle-building, like track-laying, is an art in itself. Under the efforts of trained men it grows like a mushroom, and once the lowest bents are secured in position upon a firm and rigid foundation of piles, the remainder is easy from their point of view.

It does not rise up a single log at a time, but by the 100 feet, for the bents as built are left prone in position, and when a row is completed a steam-engine and tackle hauls them into the upright position one after the other with astonishing rapidity. When the top is gained it is just wide enough to carry the track and no more. If you happen to be crossing the trestle afoot, and be trapped by an approaching train, you have to be an expert athlete to escape an untimely end. You cannot lie down flat between the rails, in the hope that the engine will pass over you, because there is the deadly cow-catcher to murder you ; nor can you lie prone outside the metals, since in that case your brains will be battered out by the cylinder or the connecting rod. The only possible means of escape is to hang over the edge by your fingers, dangling in mid-air, or gain one of the side recesses—a little overhanging platform made at intervals and equipped with a butt of water for fighting fire in the event of the mass becoming ignited—and that entails a healthy race with the odds invariably against you.

The number of timber trestles on the Grand Trunk Pacific Railway has been reduced to the minimum. They have only been provided temporarily, owing to the delay in securing the steel for the metallic structures. To have waited for this material would have thwarted construction very severely. The steel-work will be introduced over the waterways at leisure, the existing trestling serving as false-work for its erection, and, after this task has been completed, all wood will be cleared away from the metal, while the rest will be buried beneath an earth embankment. Yet these structures are terribly ex-

FERRYING ACROSS THE MACLEOD RIVER

To transport material across the deep, swiftly running, wide mountain rivers, the engineers have introduced "current ferries," which are rectangular pontoons attached by a trolley to an overhead cable. The river current propels the craft, the ferry being turned at an angle so as to offer an obstruction to the running water.

THE EASTERN ENTRANCE TO THE ROCKY MOUNTAINS

The River Athabaska debouches from the Rocky Range through a wide rift. Its waters wander over the whole area between the mountains, forming a general swamp interspersed with sloughs and lagoons. In the distance is the Fiddle Back Range, whose snow-capped peaks tower from 8000 to 10,000 feet into the clouds.

pensive. Why, one only 12,000 feet long cost $50,000, or £10,000, to build. Such an outlay for a temporary erection appears to be out of all proportion to the results obtained.

Now and again the builders ran into an unexpected obstacle, especially on the slopes of the hills dropping into the valley. The flank was found to rest on a treacherous foundation—a slipping clay which, when water gains its proximity, causes it to slide bodily to and fro. Here and there the builders built their line during the dry season over a brow, taking an easy swing round the projecting humps. When completed it had every appearance of being absolutely substantial. The wet season came on, and in a short time, under the vibration and weight of passing trains, the whole slipped bodily several feet down the hill-side, carrying the track with it, or else imperilling its safety.

The builders retraced their footsteps and endeavoured to overcome this development. They excavated into the hill for a new path, and banked up the wall of earth to prevent it caving in. Sometimes the permanent way held and sometimes it did not. In the latter case the engineers would make another effort. As heavy excavation into the hill-side did not give the requisite solidity, they struck out boldly from the slope and built up a new embankment on timber trestling. More than once after they had commenced such a solution they ascertained that no better results could be obtained, so they returned to the site of their first endeavours, and by heavy piling sought to pin the slipping mass together. Invariably they succeeded, inasmuch as they had resort at the last moment to the most expensive manner of solving the problem.

I saw a striking example of this maddening opposition of Nature when I gained the MacLeod River, which at the time of my arrival was the most westerly point to

which the track had been completed. The line crosses Wolf Creek, an insignificant stream scarcely 20 feet wide flowing into the MacLeod River, but to span which had necessitated the erection of a temporary lofty wooden trestle 652 feet from end to end, by 125 feet high. At the western arm of this trestle a deep cut was entered to gain the east bank of the waterway. At places the cut was some 40 feet in depth, and the soil was gumbo, a hard, clay-like material which almost defies excavation by pick and shovel. Three hundred men had toiled night and day continuously through the previous winter, hewing their way forward with dynamite until 130,000 cubic yards of earth had been removed. The engineer retired from the scene satisfied with his labours, but the arrival of spring brought dismay. Departing frost released springs innumerable. The whole mass slipped from either side into the cut, and what were left as symmetrical, smooth-sloped banks, now became broken up badly in all directions, threatening the locomotive track which was being used for the haulage of material for the steel bridge over the MacLeod River. The aspect of that cut was ominous; the engineer informed me that almost as much material as had been excavated in the first instance would have to be taken out before the track could be laid, for gumbo is a highly treacherous soil. The navvies express a severe detestation for it, while the rock-hogs dislike it because it will not split up so well as the hardest rocks, and blow-outs representing so much lost effort have to be faced continually.

The Grand Trunk Pacific Railway has been built essentially upon the British model. It is as unlike the average American railway as it is possible to conceive. The road bed is ballasted to a depth of 18 inches, giving a firm foundation for the sleepers. The rails weigh 80 pounds per yard, and though they are not chaired, as is the practice on British systems, but are spiked to the

sleepers, yet they give a billiard-table track conducive to fast travelling without the slightest sign of oscillation or vibration. Regard has even been paid to the erection of the telegraph line, which is built in a business-like manner, and with due regard to a neat, trim appearance. The posts are not fashioned from trees for which no other useful purpose could be found owing to kinks and twists, and which when set alongside a railway present a bizarre appearance, nor are they of varying lengths and thicknesses. They are as straight as scaffold poles, of uniform thickness, cut to certain lengths, are planted vertically, and set equidistantly from the track, so that the line of wires has that peculiarly British methodical appearance.

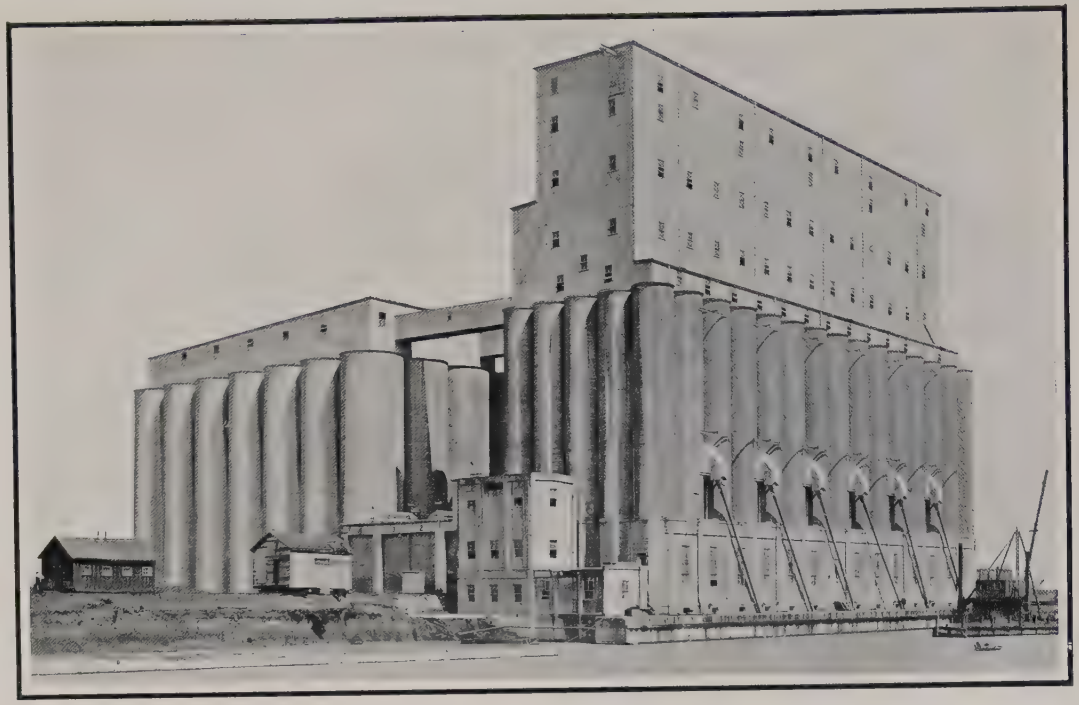
At intervals of 7 miles sidings are provided to permit trains travelling in opposite directions to pass, for it is only a single track, though the width of the right-of-way will enable two or more lines to be laid to meet future exigencies of traffic. Stations are distributed freely, ranging from 4 to 9 miles apart, according to the requirements of the locality. Between Winnipeg and Edmonton, a distance of 793 miles, five divisional points are provided, which indicate the length of an individual locomotive's run, this varying from 118 to 140 miles. At these points extensive sidings have been laid down, together with buildings for the housing of locomotives and other requirements of the railway. Moreover, the whole line is subdivided into sections 12 miles in length, for the maintenance of which the section man or ganger is responsible.

Seeing that this railway bisects a continuous stretch of agricultural land unrivalled in fertility on the North American Continent, and stretching for almost 1000 miles continuously—a feature which has been responsible for the birth of the colloquialism " Canada's One-Thousand-Mile Farm "—it does not require a second thought to show that the main source of revenue to the railway will be grain. Such, in fact, will constitute the essence of its

existence, and it will carry a large proportion of the river of wheat which flows every autumn eastwards to Winnipeg and the points beyond. Accordingly a shipping point on the Great Lakes became imperative, in order to give the railway its own independent vent to the great Canadian waterway system. This connection debouches from the main line 225 miles east of Winnipeg at Lake Superior Junction, and after running for 188·8 miles through very broken and difficult country, gains the head of Lake Superior at a little indent near Mission River. Here a new town and port have been established—Fort William—and although it is within a tram-ride of another bustling centre, Port Arthur, the younger port has gone ahead so rapidly that it promises to outstrip its competitor completely, while the keen rivalry existing between the two centres situate side by side is a healthy contribution to the welfare of both.

But Fort William's future is secured by one of the most colossal enterprises that has ever been attempted in the history of the Canadian west and the raising of grain. The increasing yield of the prairie has taxed the question of storing the produce until required by the market to a supreme degree. The Grand Trunk Pacific, looking into the future, decided that at Fort William there should exist facilities for meeting the requirements of the Great West for many, many years to come, so the construction of a gigantic grain elevator was taken in hand. For this purpose 1600 acres were acquired bounded on three sides by water—the Kaministiquia River, the Mission River, and Lake Superior respectively. By this means no less than 7 miles of water frontage were secured, thereby bringing the huge freighters trading on Lake Superior into touch with the railway.

The wisdom of this step is being substantiated already. In the autumn of 1908, although there was not a single freight train running on the completed portion of the



A Gigantic Grain Elevator

A gigantic elevator has been commenced at Fort William, at the head of Lake Superior. When completed it will store 64,000,000 bushels of wheat. It is fire-proof throughout, being built of ferro-concrete.

Grand Trunk Pacific, the farmers who had settled in advance of the iron horse succeeded in shipping to Winnipeg approximately 1,000,000 bushels of grain, the whole of which was handled as conditions permitted by the construction trains. In the following year a freight train service was inaugurated, and as a result several million bushels were brought down to the capital of Manitoba, where, as the Grand Trunk Pacific had no outlet to the Lakes, the whole traffic had to be handed over to rival lines for consignment to points beyond. In 1910, by dint of hard work, the Government completed the short link between Winnipeg and Lake Superior Junction, and as the first unit of the elevator at Fort William was completed the railway was enabled to convey the grain direct from the farm to the lake-side elevator over its own metals.

This elevator, when finished, will be one of the great sights of the west. The completed section is already a dominating landmark for miles around, inasmuch as it holds 3,250,000 bushels of grain. This appears an enormous bulk, but it is insignificant in comparison with what the complete installation is designed to contain, which aggregates 60,000,000 bushels—truly a huge storehouse of cereals.

This elevator represents the last word of modern science and engineering in connection with the storing of grain. It is totally different from any similar structure in the west to-day. It is built of ferro-concrete, the latest constructional material evolved by scientific research, and consequently is fire-proof throughout—no mean feature, bearing in mind the tremendous wealth which the structure will hold ultimately, and which at the present prices would represent something like $40,000,000, or £8,000,000.

In view of its massive proportions, the preparation of the foundations presented an intricate problem.

In the first place, owing to the unstable character of the ground on the site, an army of pile-drivers had to work continuously day and night, driving piles 50 feet into the ground until over 11,000 tree logs had been planted in the bog. Upon these a solid plinth of concrete several feet in thickness was laid to support the superstructure. Steel and concrete were the sole building materials employed, with windows of wired glass, so that the utmost protection against the ravages of fire has been secured.

The working house measures 237 feet in length by 137 feet wide. It is provided with eighty huge cylindrical bins—wells, in fact—measuring 12 feet in diameter, into which the wheat is poured and drawn off in a steady golden stream. The spaces between the bins are also pressed into service for storage purposes. Immediately beneath these capacious wells are fifteen large grain-cleaning machines, while above the bins are further machines for cleaning flax-seed, and for separating the screenings of the other machines into the various descriptions of seed of which they are composed. There is a cupola above the cylindrical wells, and here are ranged ten 2000-bushel scale-hoppers, resting on 120,000-pound hopper scales, each scale-hopper in turn being surmounted by a 2500-bushel garner. Five of these apparatuses are used for weighing the grain as it enters the elevator, while the other five weigh the outgoing grain before it is discharged into vessels or railway cars.

Down on the ground level are four tracks passing through the building, and for a sufficient distance beyond to enable loaded cars to be shunted in twice a day. Five hoppers are disposed alongside each of the four tracks within the building, making twenty hoppers to the house. Each hopper can take a car-load of grain. Capacious shovels serve to empty the grain from the cars into the hopper, these being of unusual size and strength. Beneath each

row of hoppers extends an endless conveyor, which carries the grain from the unloading hopper to one of five elevator legs for handling incoming grain. Each of these elevator legs can deal with 15,000 bushels of grain per hour.

For unloading purposes there are six large chutes, whereby the grain, after being weighed, is sent in a steady volume into the holds of steamers or into railway cars. When the whole battery is working at maximum pressure, the elevator is being depleted of wheat at the rate of 90,000 bushels per hour. In addition to the foregoing, the establishment is replete with a host of other time and labour-saving devices, so that manual effort is reduced to the minimum.

The storage house contains seventy cylindrical bins similar to those in the working house, only they are of larger dimensions, being 23¼ feet in diameter, with the space between similarly pressed into service for storage purposes. Conveyors communicate these bins with the working house, and also with the discharge chutes for shipping, each of the conveyors being able to deal with 15,000 bushels of grain per hour.

When the whole plant is completed, and working at full capacity, it will be possible to deal with the grain brought in by 2400 cars every day, and to load vessels moored alongside at the rate of 300,000 bushels per hour. Such affords a graphic idea of the tremendous proportions the grain industry is expected to attain along the track of the Grand Trunk Pacific, the whole of which will have been created by this one line. The machinery within the elevator is driven by electricity, the current being drawn from the Kaministiquia Power Company, at 22,000 volts, and broken down in the building to meet requirements for power and lighting.

The work in connection with the building of this enormous grain warehouse is only equalled by the extent of the operations outside for the provision of suitable

facilities for shipping. Where a short time ago was low-lying, swampy land covered with trees at the entrance to the Mission River is a first-class wharf built in ferro-concrete. Millions of tons of material have had to be dredged away to provide a deep-water channel leading from the Grain Elevator to the deep, navigable channel of Lake Superior. By the provision of this enormous depository the railway has forged a powerful link with the water-borne traffic through the lakes, in which the shipment of grain is a very important factor, and co-operation with which cannot fail to influence the welfare and prosperity of the railway, since it secures to the latter a state of complete independence.

The completion of the line between Winnipeg and Edmonton has imparted also a fresh impetus to the development, not only of these two cities, but to the country lying between. Not only does the Grand Trunk Pacific line represent a saving of some 20 miles in distance between the capitals of Manitoba and Alberta, as compared with its competitors, but the travelling time has been reduced by no less than six hours ! The expresses cover the 793 miles in less than thirty hours, while special trains have accomplished the journey in twenty-four hours. Owing to the solid construction of the permanent way, the easy grades, excellent ballasting, and other features conducive to fast, smooth travelling, commercial interests are anticipating a twenty-hour service between the two cities. When the track has settled down to its work such will become *un fait accompli* without a doubt, as it is fully within the realms of possibility. The track is quite capable of enabling speeds of 50 and 60 miles an hour to be obtained, being, in fact, the fastest piece of line on the North American Continent.

CHAPTER XI

TOWNS AND CITIES BUILT TO ORDER

TEN years ago the vast tracts of prairie rolling westwards from Winnipeg to the Rocky Mountains through those stretches of Manitoba, Saskatchewan, and Alberta lying between the 50th and 55th parallels, were populated as sparsely as the Sahara. Here and there might be found an isolated homestead, where a daring settler had braved loneliness, inaccessibility, and remoteness, among the Indians who roamed the plains, but for the sign of town one looked in vain for miles. Contrast that aspect of ten years ago with what is to be found to-day. Between Winnipeg and Edson, a distance of about 920 miles, over 120 towns have been created in a long-flung-out line upon the prairie, and each is a humming hive of activity and industry.

One and all owe their birth, and even their existence, to one factor—the Grand Trunk Pacific Railway. As the prairie was opened up, and the rich, dank grass on which the buffalo thrived so fatly half a century back was turned in to make room for the golden wheat which feeds the world, strategical commercial points were seized here and there for the establishment of a central collecting and distributing point over an area of surrounding territory which the farmer had invaded and occupied. These communities, like the railway itself, have been selected methodically and laid out scientifically. The "town-boomers," a genus which came into existence likewise from the progression of the iron road through the new country, and whose one speciality is speculation and preying upon the gullible, considered this a magnificent opportunity

for making money quickly and easily. They entered the country early, and endeavoured to establish town-sites here and there along the located route of the line, buying the land up at a cheap price, and unloading it upon those who had fallen victims to the town-boom fever at fictitious prices. They did not hesitate to assume grandiloquent titles of such a character as to lead the public to believe that they were acting for the railway in an official capacity, and that property bought through their offices was certain to appreciate in value at a rapid rate.

The career of these speculating mushrooms, however, was meteoric. The railway company was going to decide where the towns should be planted, and in this respect they refused to be influenced by external interests which had no regard for the general welfare of the population settling upon the country fringing the line. In the first place they promptly saved the incredulous from the hands of these fleecing individuals by protecting their title. The words " Grand Trunk Pacific " which possessed such a magic fascination to uninitiated speculators were copyrighted. Consequently any Canadian organisation attempting to trade under a name which introduces these words in any trading form becomes subject to action, and can be strangled at its birth by the stern arm of the law.

Foiled in this direction, the ingenious town-site plotter resorted to other artifices in order to gather in the dollars of poor investors. He struck out boldly, closely examined the country, and then boldly announced that towns would have to be situated at such and such a place, whether the railway willed or otherwise, and in this manner sought to induce the investor to part with his money.

This lure succeeded for a while, but it was realised very quickly that the railway dominated the whole situation. Commercial interests always flocked around the point where the train stopped to take up and set down passengers and merchandise. The railway station

always became the hub of the community within a certain surrounding radius.

This tendency gave rise to some very amusing incidents and illustrations of the powerful settling force of the railway. The speculating element had pushed far ahead of the line into Alberta along the location, and a place called Denwood sprang up. True, it was but a small village, but the fact was maintained that the railway would have to establish their station at that point. The speculators tolerated a rough-and-ready existence for several months, dwelling in rude shacks and tents, and subsisting as best they could. The future of Denwood was their sole topic of conversation, and many a pioneer built a magnificent castle in the air. The outlook was considered all the more rosy from their point of view, since Denwood would have to be made what is known as a divisional point, that is to say, a station of more than ordinary importance, inasmuch as it would indicate the end of a running section—the point where the train would have to change engines. Consequently round houses, extensive sidings, and various buildings essential to the railway's purpose would have to spring up, and these in their turn would require labour which would have to live in the vicinity. From the flamboyant tone in which the speculators discussed the prospects for Denwood, a stranger within its precincts might have come to the conclusion that he was standing upon ground which was destined to become the Winnipeg of the Middle West.

Any scrap of intelligence regarding the approach of the steel, as the rail-head is called, was devoured and discussed with keen delight. As the line crawled gradually closer and closer excitement and enthusiasm rose to fever pitch. On July 25th, 1908, the rails forced their way into Denwood, and those who had been waiting so long and patiently considered that the prizes were theirs at last. Many a " boomer " saw his pocket bulging with

dollars accruing from the result of his determination and success in being first on the spot.

The next day their feelings of joy gave way to dismay. The line continued its progress as if Denwood were at the North Pole. The speculators rubbed their eyes. What! Was Denwood going to be overlooked? The engineers did not know; they could give no intelligible reply. Ah, well, perhaps the steel was pushing ahead with renewed vigour to meet some condition beyond which was not conspicuous to the "boomers," so they sat down to another period of waiting. Suddenly they learned the truth. Denwood, "the coming metropolis of the Middle West," despite its attractive situation, was useless to the railway. Their point was 2½ miles farther west, and they had named the station Wainwright. This was to be the divisional point. Then ensued a mad stampede from Denwood. The "boomers" packed their tents hurriedly, the log buildings were emptied of their contents and demolished, and one and all hurried to Wainwright as best they could, and with what vehicles they could command. Within a few hours Denwood was stripped of everything; there was not a soul or a vestige of its recent occupation to be seen in the place. In a month it was forgotten; it was but a dream, and to-day you might search in vain for the place which enthusiastic optimists averred was the cradle of a second Winnipeg.

It has been the same over the whole 1000 miles between Winnipeg and the foot-hills of the Rocky Mountains. Fortunes have been lost in the mad scramble to make money quickly and without effort, merely by speculating in town-sites; wealthy farmers have been beggared through being lured from the certain wealth to be won from their land by persistent labour, and having lost their all, have been forced to commence life over again.

The creation of these new communities has been planned

upon the most careful scientific lines by the Government and the subsidiary official company which is carrying out the foundation of cities and towns along the route of the Grand Trunk Pacific Railway. As already explained, the charter of this railway did not include the free presentation of a square foot of land. That required for town-sites had to be purchased in the ordinary way, and this work is carried out by an enterprise quite distinct from the railway company, though officially representing the latter. The railway company selects the spots which it considers suitable for divisional points, and the towns distributed between are founded according to local requirements by the Town-site Company. They purchase, say, a square mile of territory abutting on the railway. One quarter of this area has to be presented to the Government free of all expense, since the latter maintains a 25 per cent interest in all such speculations, and the revenue derived from the sale thereof pours into the Government treasury.

Location having been settled, the plotting of the area is then carried forward. Corps of surveyors appear on the scene and the streets are pegged out. Canadian town-planning is now practised exclusively upon the methodical geometrical system elaborated in the United States. The main up-town thoroughfares are driven in one direction, and the lateral streets are carried at right angles and spaced equidistantly, the section between two succeeding highways being known as a block. The lateral thoroughfares are spaced about 300 feet apart, so that approximately twenty blocks equal one mile. Such planning gives the town a square and monotonous appearance, but it has the compensating advantage of facilitating the discovery of any desired address, especially if the numerical system of christening the lateral streets is adopted. The highways laid out, the rectangular blocks of land lying between the latter are subdivided into plots,

each averaging about 50 feet wide by 150 feet deep. Each purchaser thus receives an equal unit of the land for his money. These plots are then divided once more into inner and corner plots. The latter, as the name implies, represents plots having a frontage upon two thoroughfares, and consequently, from the commercial point of view, are more valuable than the "inner" plots, which are those lying between the corner areas in the street and having only face frontages.

Frustrated in their efforts to establish towns in a promiscuous manner, and thus to plunder the public, the "town-boomers" resorted to another practice. When a town is ready for occupation, the first sales are conducted by public auction. Such pending disposal is advertised far and wide, and focusses the attention of the legitimate investor squarely upon the project. Also it enables some idea of the value of the property, when in its earliest stages, to be ascertained, and contributes somewhat towards the fixation of fair prices for private sales. The lots offered under the hammer are not consecutive, but are picked haphazardly from all parts of the site, since those which are immediately contiguous to the railway station obviously are more valuable than those a mile distant. The speculators always patronised the sale in full force, and purchased the plots which they considered to be the most attractive to hold until circumstances arose enabling them to sell out at an inflated figure. Then, upon the conclusion of the auction sale, they would command all the most attractive plots, at prices approximating what they had paid under the hammer for such property, and since they were only compelled to pay a small sum down, with the balance in subsequent instalments at 6 or 7 per cent interest, they were able to control the situation completely. They sent up the prices of the plots to a prohibitive figure, and often out of the sale of a few plots to luckless buyers,

were able to defray the outlay upon their entire speculation. It will be seen, therefore, that the genuine investors stood a very indifferent chance of laying out their money legitimately and profitably.

This method was all very well in its way, but the authorities saw that such practice might arrest the development of a town. In fact, the speculators, by securing the finest lots, could hold up the place, and yet not spend a penny towards its improvement. Now, inasmuch as the land immediately surrounding the station is the most valuable, is most likely to witness development first, and invariably is the point from which the upbuilding of a community springs and radiates in all directions like a fan, it is essential that it should be exploited without delay to enable the town to be set firmly on the path of prosperity. A stranger detraining and observing the vacant appearance of a town around the station where there should be bustle would think naturally that something serious was the matter. So, in order to prevent such a state of affairs, the authorities established what they called a building restriction. This applies to a certain radius immediately around the station. Generally it covers four blocks. The purchaser of land within this area is compelled, by the terms of purchase, to erect a building on his plot worth $1500, or £300, at least, within a year of his acquisition of the site. This has hit the boomer rather hard, as when he buys a plot development such as this is the most remote intention he has in mind. Consequently he leaves the " restricted area " severely alone, but buys up outlying cheap plots, and endeavours to foist them upon the public at about ten times their value by hook or by crook.

The towns fringing the Grand Trunk Pacific, which on the average are spaced about eight miles apart, are all located on the northern side of the line, with one or two exceptions. The principal thoroughfare striking directly

from the station is always the Main Street, and is generally known as such. It is a noble highway 80 feet in width, which provides a 60-foot roadway. The parallel highways on either hand are about 66 feet in width, and these often are named after the English practice or as avenues with a numerical designation. The same applies to the lateral thoroughfares, but Main Street retains this appellation invariably, and as such conveys the intimation that it is the thoroughfare leading to the railway station.

In some instances remote spots on the prairie having no ambition towards blossoming into a city or town have had greatness thrust upon them. Take Irma, for instance. It was a mere dot on the rolling expanse, and four years ago a half-breed's tumble-down shack was the sole evidence of settlement for some 20 miles or more around. A United States farmer, Mr. W. H. Fread, had cruised around the western prairie searching for a new farm. After covering some 2000 miles he decided upon a district some 35 miles west of the Battle River. He returned home, and, succeeding in persuading some thirty-five families to accompany him, the party set out for the north-west, gained the territory, and at once settled down to farming. The Grand Trunk Pacific Railway was some distance to the east. To replenish their provisions, and to obtain supplies, they had to drive over the ancient trail to Viking, a small town 27 miles to the west. This little colony set to work industriously, and in a short time changed the aspect of the prairie completely for miles around. Then along came the steel highway, and in passing through the rich country, and observing the prosperity of the little colony, it was decided to stop the trains here, and a station christened "Irma" accordingly sprang into existence. Unlike the greater number of the western prairie towns, Irma never has had a boom. It was advancing steadily and rapidly by the time the railway arrived, and offered no scope for the town-boomer.

The growth of a prairie town is a spectacle that cannot be paralleled in any other country. The location of the town is decided definitely, and in a few days the site has been split up by the surveyors. Before they have settled down thoroughly to their work one or two stray pioneers arrive and cast about, possibly assisting the surveyors in menial work, with a view to gathering some tit-bits of information likely to be of individual profit. As the surveyors' work approaches completion other stragglers appear on the scene, and before one can realise the fact, squatters appropriate attractive plots and run up their tents. In a few days a livery stable appears, while within easy distance a frontier hotel springs into existence.

Two days later the place is overrun by investors and speculators, who penetrate to the point in any vehicle at their disposal, and their arrival is hailed with delight by the livery-stable keeper and Boniface. Within another two days many a visitor has exchanged his cash for a piece of Canadian freehold, and before the week is out a store, lumber-yard, a variety of timber frame buildings serving as stores, restaurant, barber's shop, possibly a newspaper, and private dwellings line the main thoroughfare. The complete change from barren, undulating vacant wilderness to a small village of thirty or fifty people has often been wrought in a week. Where one Sunday revealed but the tents of the surveyor and his staff, the following Sunday has shown an assortment of buildings of all descriptions.

In due course the bank, school, and church rise up from the ground. The new town has now commenced its forward movement in earnest. Every day sees a new arrival, resolved to try his luck in a locality where competition is not encountered, and where there is full scope for unfettered ability. If the town happens to be a divisional point, its progress is much more marked, for by the time the railway settles down to business, the inhabitants may look forward confidently to the company spending something like

$30,000, or £6000, a month in wages among its employees stationed at that point. The elevator appears like magic beside the railway track, and the farmers around the town breathe freely, for here are the facilities for the disposal of their produce on the spot.

In some instances the rise of the town has been phenomenal. Take Melville, a typical town born of the railway. Three years ago it was not even a dream—where it stands was a mere expanse of prairie stretching away to the horizon on either side. In three years it had become the home of 1500 people who had installed their own telephone service, were discussing an electric lighting system, and had an assessment value of $1,500,000, or £300,000. Watrous can relate a similar story of rapid growth, as can also Wainwright, Scott, and one hundred other towns scattered along this railway. To show how wealth can be brought into a district Scott offers a concrete example. It is the centre and distributing point for one of the finest and most fertile grain-growing areas on the prairie. One afternoon a train-load of ninety wealthy American farmers, seeking new homes, drew in. The visitors inspected the surrounding country, and before they re-entrained that evening over $68,000, or £13,400, had been deposited in the local bank as payments for the land acquired.

Saskatoon and Edmonton are two towns which reflect the sudden rise of barren prairie to eminence and wealth. It was quite by accident that Saskatoon came to be founded at the point where the Saskatchewan describes a huge elbow. Those who first settled on the spot thought that perhaps some day they would build up a town of some importance, but the settlers numbered only 113 all told in 1903. The odd thirteen might be construed as ominous to the superstitious, but Saskatoon placed no credence in such folly, for by 1906 it had grown to a town of 3011. Within another three years it had increased fourfold, and to-day has a population of 14,000. The rise of Edmonton has

MASSIVE STEEL BRIDGE ACROSS THE SOUTH SASKATCHEWAN RIVER AT SASKATOON

The great width and depth of the channels cut by Canadian rivers on the prairies is shown strikingly in this illustration. In order to cross them magnificent huge structures are required. This bridge is 1530 feet in length, and is supported on massive masonry piers 71 feet above the waterway.

perhaps been more magical. In 1901 the census stood at 2626; in 1910 it was bordering upon 30,000.

When I crossed the extreme western corner of the Dominion, making the "north-west passage" over the route which the steel highway will follow, I came upon a small clearing in the scrub. The grade was in the throes of moulding; the navvies were wrestling with muskeg and gravel. As I stood on the site for the station buildings of Edson and looked northwards, my eye was arrested by a clean level cut through the bush, merely 8 or 10 feet wide, with heavy wheel-ruts trailing through the mud and water. This was "Main Street," as unpicturesque a highway as one could conceive. I wended my way cautiously along the thoroughfare. The roadway was flanked on either side by primeval bush, with narrow passages cut through the vegetation here and there, showing where the surveyors had driven their lines. Now and again, when I left Main Street to avoid an ugly puddle, I would stumble and trip over a hidden obstacle which investigation revealed as the surveyors' pegs for the side streets and building lines. Of structures there was but the crudest sign—a square prison-looking building, with an outer garb of tarred felt, was the solitary disfigurement of the landscape. This was the hotel. Within a stone's-throw was the irrepressible livery stable—at that moment empty for want of patronage, yet well stocked with hay, ready for eventualities.

The steel had not reached the town, owing to heavy bridging being necessary to cross the MacLeod River. The outlook for Edson was about as dismal as one could imagine—the bush looked too forbidding to entice speculating builders and others eager to trade in the wilds. Here and there we met a pioneer plunging through the bush, looking for attractive sites among the slime and swamp. These were the only signs of civilisation, yet I learned that nearly every foot of ground had been bought up!

When I gained Fort George I learned that the railway

had reached Edson, and that a stirring boom had set in. When I was there six weeks before the track was 11 miles away. In the course of forty days the track-layer had forced its entry, and, in addition to the main lines running through the yard and station, there were miles of sidings, for Edson is a divisional point. The bush had been cleared for a solid square mile, and the ground was as dry and as free from any vestige of a tree as the Carberry Plains 800 miles to the east. Within another six weeks it had settled down to a humming existence, with imposing timber buildings for stores, butchers' shops, restaurant, and a dozen other businesses lining the principal thoroughfares, while the place found employment and means of existence for some 300 people.

East of Winnipeg a new town is springing up. Owing to the high cost of land in the metropolis of Manitoba, the Grand Trunk Pacific Railway is establishing its necessary locomotive yards and numerous buildings some little distance to the east. Transcona is the name of this Crewe in embryo, and an outlay of nearly a million dollars, £200,000, indicates the initial outlay on the part of the railway. Around this hub has been planned and plotted housing accommodation for 5000 people, most of whom will represent employees engaged in the works and yards of the line.

Such is the way in which the western stretches of desolation have been reclaimed. The enterprising farmer has occupied the arable land on either side of the line, attracted by the bounty of Nature, and the provision of excellent transportation facilities, while this in turn, under the influence of the railway, has given rise to the innumerable little towns—they will be cities some day, with the smoke from one intermingling with its neighbour on either hand—and the transformation has been truly magical. Within less than ten years the railway has been responsible for creating about 120 towns, and populating them to the extent of over 50,000 people.

CHAPTER XII

SPYING THE PATH THROUGH THE ROCKY MOUNTAINS, AND THE CAPTURE OF THE YELLOWHEAD PASS

THE plotting of a railway through the Rocky Mountains having a grade no heavier than 1 per cent, or 52·8 feet per mile, had been the dream of American engineers ever since the day when Stephenson first demonstrated the possibility of driving a vehicle having a flanged wheel over a smooth-surfaced rail by adhesion. Though they had struggled desperately and repeatedly to achieve their ambition, Nature had always baffled them completely. Those yawning ravines and sharply rising, towering peaks always had defied such an easy conquest—had upset their most carefully laid plans. Strive as they might, braving snow, cold wind and weather, they never could alight upon a pathway such as they desired. It seems a simple matter to say that a grade shall not exceed so much when it is written on paper, and it looks very attractive, but when it comes to laying the metals it is a totally different undertaking.

So when the President of the Grand Trunk Pacific enterprise warned his surveyors that the grade for the new line must not exceed four-tenths of 1 per cent, or 21·12 feet per mile, through this formidable mountain chain, engineers throughout America laughed quietly. They reasoned that they knew the difficulties which would shatter such a fondly cherished idea, for they had bitter experience to assist them in their emphatic conclusions that it would never be accomplished.

The Rocky Mountains form one of the most heart-breaking barriers that Nature ever presented to the railway builder. As one engineer, who had toiled among their fastnesses for more years than he could remember, picturesquely remarked, "Nature either must have grown tired or disgusted in her moulding work when she got to North America. At any rate, she just threw the mountains down promiscuously, and in the most confused heap of lofty peaks that can be imagined." She had no thought for the railway-builder, coming along centuries after, the privations he would have to suffer, the perils that he would have to face, and the fatalities that their conquest would occasion, just to spy out a narrow passage where the rails could be carried through comfortably and without assuming the form of a gigantic switchback.

It is a tumbled ice and snow-fettered chain from end to end. The rifts between its tangled, precipitous teeth are few and far between. Those that exist are merely lanes for the egress of boiling, tempestuous waterways, lashing the sides of the gorge. When a rushing river occupies the whole of the ravine the task of the railway-builder becomes Herculean in the truest sense of the word.

Consequently, when a small band of picked men expert with the transit and level, with constitutions as hard as nails, who from long experience in selecting paths for a railway through the most difficult stretches of country could discover such almost by instinct, were merely told by their "chief" that they were not to exceed a "four-tenths grade," it is not surprising that they were somewhat amazed. Argument was useless. It was of no avail to say that such an undertaking would cost millions to accomplish. That was a question for the controlling spirit to settle. Their instructions were explicit.

The surveyors set out. Many wiseacres who knew the Rockies described their expedition as the "forlorn hope." Certainly they had been entrusted with one of the most

THE "RIBBON OF STEEL" THROUGH THE CASCADES

The engineers followed the course of the Skeena River through the Cascades to connect the interior plateau of New British Columbia with the coast. The line has been laid upon a heavy embankment of rock-rubble at the foot of the mountains, and is sufficiently heavy to withstand the violent scouring action of the river when in flood.

exacting tasks that has ever been imposed upon a railway-building spy. The party was in charge of one of the most accomplished railway surveyors in the west, Mr. C. C. Van Arsdoll, who has been associated with railway engineering all his life among the Western American mountains. Roughing it in the wilds appears to have rendered him immune to the many ills to which flesh is heir, and he is prepared for any emergency. His tall, gaunt figure striding through the dense bush is familiar up and down the banks of the Skeena River and throughout Northern British Columbia to-day, for as divisional engineer he is responsible for the construction of that length of railway. It may be raining as it only can rain on the Pacific Coast —and the character of a downpour may be gauged somewhat from the fact that the annual rainfall is about 109 inches—but he recks not of the elements. A lounge jacket is quite sufficient protection, and even should it become sodden like a sponge, a stand-up before the camp fire will dry the garment very quickly. A man of few words, and those uttered in a very low tone, the men on the work tell you that "every one counts," for a stern wrestle with Nature day after day for supremacy among the mountains is not conducive to conversation or idle talk.

With him was associated a kindred spirit. This was Mr. R. W. Jones. Railway spies among the secrets of Nature in the mountains, like poets, are born, not made. And Mr. Jones certainly knows the Rockies through and through. In the search for the breach in this frowning wall through which the Grand Trunk Pacific could be carried in the easiest manner he probed the barrier through and through, exploring in all about 10,000 square miles. It was not open country that he traversed, but the heart of the range, bristling with precipitous, snow-crowned caps, which he trod through and through for the slightest sign of a passage, which, upon discovery, no matter how narrow, was followed up till it either came to a dead-end, comprising as it were

a huge couloir, or sloped up towards the clouds. Every little detail was scrutinised closely, and committed to memory and paper by means of an eye trained to the country from prolonged seclusion in the wilds. Nothing escaped his vigilance. It might have been a narrow ledge here or a gully there, but it was searched industriously, in the hope that it might help to solve the problem in hand.

The elements were spurned, and the seasons almost passed unnoticed, so deeply was he absorbed in his task. Now pushing along through bog and slime, then slipping and sliding among rocks, struggling with dead-fall piled 10 or 12 feet in height, and as tangled as a skein of wool, or cautiously fording a tempestuous torrent born of a mighty glacier, his daily round was one of continuous adventure. The country might be tightly embraced in the icy grip of winter, but it made no difference. Then snow-shoes were donned to facilitate movement over the white mantle, while supplies for the daily needs were carried in a small pack strapped to the back.

The most remarkable phase of his task was the flying survey, wherein the country was reconnoitred hurriedly but thoroughly. Jones went off with but an Indian to keep him company. The red man, Pierre Belcour by name, has accompanied his " white chief " so often that the two are almost inseparable companions. Pierre is one of the last of a fast-dying race—a typical Indian such as has been handed down to us by the fiction writers of Canadian aboriginal life and ways. He is a stoic of the front rank, will plod along for hour after hour without a murmur, and possesses the red man's characteristic instincts to an acute degree. Swift afoot, a keen hunter, and a boon companion, he is an ideal friend, philosopher, and guide. There are many who will spurn disdainfully the idea of a Red Indian as a colleague, but in reality he would be difficult to excel, as he can find his way through the trackless labyrinth of forest as easily as an ordinary man can wend his way along

a high road provided with sign-posts, and in a tight corner he is just the man to help one out. Moreover, a true Indian never grumbles, for it is against his nature. He simply takes the rough with the smooth, though in the wilds more of the former than the latter is encountered. It is certain Jones scarcely ever would think of setting out on an expedition without his faithful shadow.

Their general practice was to start off with no more than a sleeping-bag apiece strapped to their backs, and with pork and beans constituting their staple diet, to be reinforced with what they could bring down with their rifles, or trap from the creeks and rivers. Personal impedimenta was reduced to the very uttermost limit. When traversing such difficult country as the Rocky Mountains the lighter the load the easier one can advance. With this scanty outfit they tramped the woods, living a true Indian life, scaled the mountain summits, and investigated the narrow defiles. When a thundering river had to be crossed they fashioned a crude raft from dead trees as best they could, abandoning their primitive craft when they had gained the opposite shore. They struggled until waning day compelled cessation, and then piled up a blazing fire. If they were out of provisions, and no luck had fallen to their rifles, they simply went supperless to bed, their couch being the bag in which they curled themselves before a blazing camp fire. Up with the break of day, they packed their beds into a small compass, re-strapped them to their backs, and trudged off on another trying round.

As one travels in the comfort and ease of a Pullman car, one cannot form the slightest idea of the toil, adventure, and privation that the plotting of the route which the completed line follows has entailed. One may admire the audacity of the engineers in connection with the work as it is presented by the completed line, but one does not see the infinite labour that was expended in providing that route, nor can one realise how its course

came to be decided ultimately. To gain a faint idea of this invisible effort, one must struggle ahead of the constructional engineers, cling to the narrow trail, struggle with bog, dead-fall, and sliding rock, as I did for a few hundred miles, and then a slight conception of the proportions of the surveyor's labour is obtained.

Our pack-train was toiling along the Miette River towards the Yellowhead Pass. The mountain-sides sheered up from the waterway at angles of about 60 degrees on either side. The trail wound like a Chinese puzzle over humps and through couloirs, where riding was a painful task, while the speed was comparable to a tortoise's gallop. The opposite mountain-sides here and there were torn by a straight, narrow line through the sea of green, running up the mountain-side. It was a trial line, showing where the surveyor had cleft his way through the trees at infinite pains to gain a position to enable him to bring his instruments into use for plotting the mountain slopes. The finished line, following the easiest route, seems so obvious to the uninitiated traveller that he thinks survey work mere child's play, not knowing that possibly fifty lines or surveys had to be run before one mile of track along which he is speeding was found to be the best.

While toiling along the route which the railway is to follow through the Rockies I spent several days among the resident engineers and camps, where I met more than one hardened young fellow who had been out on the preliminary with Mr. R. W. Jones. All could relate exciting adventures without end, some grave, some gay, but all pointing to the perilous character of the task.

"Did you ever see the grizzly that Jones shot with his '22'?" commented one. "Phew! it was a stunner, and no mistake. A pretty close shave for Jones, though!"

He then related the episode. It appeared that the surveyor-in-chief was out with an assistant plotting the line with the transit and level. While hacking their way

through the bush the assistant spotted a grizzly, and let drive in a true sporting manner. It was an indifferent shot, simply wounding the bear pretty badly, with the result that the brute rounded and made after his assailant. A grizzly may be a lumbering, ungainly brute, but it can cover the ground at a healthy speed. The young assistant had not time to reload and fire a second shot, so, yelling out to his chief, turned on his heels. Jones whipped round, and spotted enraged Bruin barely 20 feet away, and coming for him at full speed. Escape was hopeless, as the bear would have been on top of him within a few seconds. He had only a small "22" in his hands, which, generally speaking, is about as useful for bringing down a grizzly as is an air-gun for stopping a mad bull. However, he drew, and taking steady aim at the advancing animal, let fly at a range of about twelve paces. He then stepped smartly to one side. The bullet caught the brute in the face, and, just missing the frontal bone, pierced its brain. The impetus it had gathered caused it to stumble forward for a few feet farther, to drop dead almost on the point where the surveyor had been standing

On another occasion two surveyors were running the preliminary. The transit had been left a little to the rear, and, not being required for the moment, its waterproof hood had been replaced. The surveyor and his companion were groping along when there was a roar, and an enraged bear rose up as if by magic out of the ground. It caught sight of the two surveyors, who, both having left their guns behind, deemed discretion to be the better part of valour, so turned and ran as hard as they could go with the bear in full pursuit. They gained safety, and after waiting awhile to regain their wits and breath, the surveyor suddenly bethought himself of the abandoned transit. Had the bear seen it ? If so, what had she done ? They instantly retraced their footsteps, fearful for the safety of the instrument. If that had fallen a victim to the enraged bear's

tantrums work would have to be suspended for weeks, as they were hundreds of miles from head-quarters. An accident to their transit in that situation would have been analogous to the plight of a captain who had lost his compass. When they regained the place they peered anxiously around. Bruin had gone, and there was the transit still standing on its tripod as they had hurriedly left it. But the instrument had attracted the attention of the bear during the mad rush ; she had stopped to investigate, and had expended her rage on the waterproof covering, which she had lifted off and had torn to ribbons. The transit itself was absolutely uninjured !

Jones and the Indian more than once occasioned considerable anxiety in the minds of their comrades. Their general procedure on preliminary and locating surveys was to establish a flying camp, that is a camp which could be moved quickly and easily from point to point. Operations would be carried out ahead of this temporary centre for a certain distance, the members of the party being out in the field all day and returning to camp at night, when they committed the day's operations in the field to paper. The surveyor-in-chief and his faithful guide would pack their sleeping-bags, and with the scantiest supply of provisions in their pockets, would start off together. They would be absent for a fortnight at a time, and then would return to camp considerably the worse for wear, with clothes bearing sad evidences from their tattered, soddened condition of battles with the bush, rocks, dead-fall, and river.

The camp itself would be provided with only a slender stock of provisions, so as not to impede progress, but caches were established at easily accessible points, where the camp's larder could be replenished. When the surveyor-in-chief had started off on one of his lengthy journeys, however, the rest of the party had to await his return. But Jones, when out plotting the railway, had but little thought of time or days. Once he and his Indian were absent for

some three weeks, and his comrades were somewhat anxious as to what had become of them. Had an accident overtaken both ? The party were discussing the situation one night, and were just on the point of sending out a search party when there was a loud whoop, and the two wanderers strode into the glare of the camp fire ravenous with hunger. The camp's larder was almost depleted, so there was no tempting supper awaiting the famished wanderers.

It was decided to make for a certain cache, some days' journey distant, without delay, the whole party being reduced to short rations meanwhile. But some of the men soon began to show signs of exhaustion as they trailed painfully along, for food had been scarce for a week past. But conceive their chagrin to find when they got to the cache that it had been devastated. Bears had discovered the hoard, and had played sorry tricks with it. The animals had pierced tins of milk, fish, and fruits, and had sucked dry the contents. Dried fruits, butter, and other comestibles had been demolished, while those edibles which did not appeal to Bruin's palate had been scattered and trampled to destruction. The animals had been having a right royal feast. Though the party was faint and famished when they lighted upon this disaster to the cache, they could not refrain from uproarious laughter. Yet it was a serious matter to them, for it meant a dismal tramp through the muskeg and forest for many more miles to the next cache, and some of the weaker members were so worn with hunger that they could scarcely stand. However, with the assistance of their stronger comrades, they resumed the wearying tramp. When at last succour was gained the jaded, starved party fell upon the food ravenously and with scant ceremony.

But semi-starvation is inseparable from this work in such an inhospitably wild country. The director-in-chief may plan the most perfect system for keeping his forces at the front well provided with food, and may elaborate extensive

machinery to ensure this end, but accidents in the wilderness are inevitable. For weeks not the slightest inkling of what the party were doing reached head-quarters. The men were buried in the mountain fastnesses, often hemmed in by inclement weather or snow-bound, but prosecuting their arduous work uninterruptedly as best they could contrive the whole time. Did the engineer-in-chief, thousands of miles behind, worry ? Not one bit. In Canada, even through the north-west, where a human form is but rarely seen, ill news travels like the wind, and had disaster overwhelmed one little party among the mountains it would have reached the ears of the chief controlling the various working strings of his organisation within a remarkably short time.

Three years had sped by, and then the results of the incessant labour in the heart of the range began to assume coherent form. No less than forty possible " passes " had been discovered, followed, investigated, and charted on paper, together with a mass of details concerning the advantages and disadvantages of each, for the guidance of the engineer-in-chief. As the results trickled in they were considered carefully. Those regarded as hopeless were thrown on one side, and in this way the possibilities were narrowed down to six. Then it was brought down to four—the Yellowhead, the Wapiti, Pine River, and Peace River Passes respectively. Each had some individual recommendatory features, and each had drawbacks. The problem was to decide which would meet the official requirements from every point of view.

The selection of the pass which the great steel highway should favour through the Rockies imposed a momentous responsibility upon the engineer-in-chief. Many such officials shrink from making a decision upon their own initiative, for the future of the railway depends to a very pronounced degree upon the chief engineer's selection. If he makes a mistake, well, it simply means that so many

million pounds have been thrown away. Should the line through a pass be costly to maintain, and difficult to keep open, he is likewise assailed. However, Mr. B. B. Kelliher, whom Mr. Hays brought with him from the Southern Pacific Railway upon his return to Canada, did not hesitate to assume complete responsibility. He is a man with courage in his convictions. Ever since he left Ireland, upon the completion of his apprenticeship, Mr. Kelliher has been associated with railway-building operations in the mountains of North America, and the experience thus acquired in one of the sternest schools proved of far-reaching value when he transferred his energies to the Dominion. It enabled him to enlist the finest surveying skill available, men who would leave no stone unturned in searching the range from crest to base, between the 50th and the 55th parallels, to discover what he desired—the most economical four-tenths of 1 per cent grade. The reports respecting each possible pass were detailed to a minute degree. After prolonged and searching perusals thereof, the careful weighing in the balance of respective costs, advantages, and economic value, he unhesitatingly decided that the Grand Trunk Pacific Railway should approach the coast by way of the Yellowhead Pass.

Not that this selection was a simple matter by any means, for the Yellowhead, the Peace River, and the Wapiti Passes pressed one another hard for preference. The Peace River Pass was inviting, because it traversed a wonderfully fertile country now attracting crowds of settlers, while the altitude was about 1000 feet lower than that of the Yellowhead Pass. But to carry the railway through that rift would have entailed the negotiation of two summits, whereas the selected route has only one summit. Consequently the Peace River Pass was abandoned. Then the Wapiti Pass appeared very attractive at first sight, but when the cost of construction through that channel was investigated, it was realised that the expenditure under

this heading would assume enormous proportions, as the amount of rock-cutting necessary to secure the easy grade would have been prodigious. So this pass was placed out of court. Considered from every point of view the Yellowhead Pass offered the greatest attractions, and events already are justifying this bold decision.

In this final moving of the pieces upon the railway chessboard a little bit of finesse was related to me by the President, Mr. Hays. A rival railway, the Canadian Northern, was pushing forward to the western sea, and it was imperative that the Grand Trunk Pacific should not reveal its hand too quickly. The point was how to throw dust in the eyes of the would-be competitor. The Canadian Northern was watching which pass was to be selected by the Grand Trunk Pacific, as it had made up its own mind in this direction, for there was just one place where their line could be carried through with the greatest success. The Grand Trunk Pacific Railway apparently could not decide whether to thread the mountains by the Pine River or the Peace River Pass. The Press took the matter up to assist them, and for some time there waged a pretty discussion concerning the pros and cons of the respective passes. The railway was making further surveys in these two passes ; this was the sole information extended to the impatient and curious public.

While the discussion was at its height the Grand Trunk Pacific authorities suddenly announced that they were not going by either the Pine River or the Peace River Passes. They were piercing the mountains some hundreds of miles farther south—by the Yellowhead Pass ! The Canadian Northern had been intent upon the latter, and its engineers had been chuckling over the fact that the Grand Trunk Pacific had, to all intents and purposes, overlooked the merits of the Yellowhead Pass, and consequently were making their own plans to penetrate the mountains at this latter point with an easy grade. The engineer-in-chief of

the Grand Trunk Pacific had found this out, and by crowding a large staff ostentatiously into the Pine River and Peace River Passes, while a highly competent party was secretly plotting the way through the Yellowhead Pass which he had decided to follow, his rivals were thrown off the scent. Directly the plans were completed they were deposited with the Government, officially approved, and in this way the Grand Trunk Pacific secured the choice of route through the mountains to the discomfiture of its rival. Such a manœuvre affords an interesting sidelight on the little friendly struggles for supremacy that are waged by railway companies when both are traversing the same new country, and how keen is the effort to secure the control of a pass offering the greatest strategical advantages.

What was more, it was found that east-bound traffic over the suggested route would have only the requisite four-tenths grade with which to contend; west-bound traffic would be slightly more handicapped, as the configuration of the country rendered it impossible to give the same gradient in each direction, but inasmuch as the increase is only a matter of 5 feet per mile, it is insignificant. Here the Rockies have been pierced at a far lower altitude than ever has been possible. The summit is 3712 feet, and this is the highest point to which the metals are lifted in their span of 3543 miles from Atlantic to Pacific. No other trans-continental railway on the North American Continent traverses the Rockies at such a low level. The Union Pacific, the first trans-continental, toils to a height of 8710 feet, while the Canadian Pacific on its two routes has to notch 5329 feet at Stephen, and 4427 feet near Crowsnest respectively, in order to overcome the selfsame wall.

When it becomes necessary to take to the water to carry out the work with the transit and level, to plot the line around or through some formidable obstruction, especially upon furious, vicious rivers like the Athabaska or the

Fraser, the excitement is thrillingly adventurous. Near the entrance to the mountains I met a young Scotsman who had been out searching the foot of the Roche Miette. When he got to the site the river was running like a mill-race round the base of this mountain which juts plump into the waterway. His raft was but a crazy structure of dead logs roped together in a hurried manner. When all was ready he stowed his transit and other impedimenta on the deck, and pushed off into mid-stream. But that raft was fickle. He endeavoured to pull it towards the rock to moor while he explored round its foot. Directly he checked its drift it began to cant, rock, and sway, and finally gave signs of foundering. The result was that he found himself up to his knees in ice-cold, swirling water, striving hard to drag him down. It was with the greatest difficulty that he could maintain his balance, but though he was swung from side to side, each successive lurch being worse than its predecessor, and each of which threatened to pitch him in the river, he completed his task, though he was on tenterhooks the whole time.

While we were toiling laboriously over the execrable trail winding along the eastern bank of the Miette River, carefully picking every inch of our way amid a pile of loose rock—the disintegrated mass which was formerly part of the mountain wall rearing above us—suddenly we heard a shout and the rap, rap of boulders cluttering down. It was a regular fusillade, and we scampered to safety, fearing a rock-slide. Glancing in the direction of the hail, we saw a young engineer coming down the steep slope floundering among the boulders, which his movements set in motion. A thick leather belt encircled his waist, and he was being steadied in his descent by a rope held by two companions on the ledge above. The line was to run through this mass, and he was looking for a new location, if such were feasible. He was endeavouring to secure a foothold amongst a loose mass of shale, which is as treacherous as surface-frozen

slush and as slippery as ice. It was an elusive effort, for each time he planked his boot down he set a mass of the loose rock in motion, somewhat to our discomfiture below, as a twenty-pound stone accumulates a respectable force after it has cascaded 100 feet or so down a mountain slope falling almost vertically.

Yet the work has its humorous side. One of the party which spent a winter in the Pine River Pass confessed that the New Year's Eve they celebrated amongst the Indians in that snow-girt country was one of the most enjoyable he ever experienced.

"The Indians invited the whole of us to their festivities. Needless to say, we accepted it cheerfully, anxious to secure some little variation in our round of monotony. There was to be a dance, and it proved to be the most extraordinary display of the terpsichorean art I had ever seen. There was an open space in the centre of the shack in which a box was placed. The red folk were grouped on one side of the apartment and we were on the other. The Indians opened the proceedings. One or two were musicians, if you can describe the tom-tom as capable of emitting music, and they created an awful noise.

"Then one of the damsels rose, advanced to the centre of the cleared space and bowed towards us. Not one of us understood their language, but we could make them understand us, and with a few words of English we proceeded very comfortably. She was inviting a partner. I must confess that we were all exceedingly bashful, and hung back until the chief of our party picked me up by the collar and pitched me into the middle of the room. That was my introduction to my partner, and as I could not draw back, I took the bull by the horns and joined hands. I do not boast any pretensions to waltzing, but that dance was the most bizarre that I ever saw. It was a kind of limp round the box to the strains and time of the music, and was remarkable as much for its monotony as slow time. Still I

completed my dance, and then, when we retired to our respective seats, and another blushing red maiden advanced in turn, I having compulsorily broken the ice, there was no hesitation among my colleagues. One after the other, we all went through the "lame-duck dance," as we termed it. Meantime the Indians, who were the embodiment of hospitality, produced native concocted refreshments, which we, in strict friendliness, were compelled to enjoy.

"Now among these Indians we ascertained that New Year's Eve is the occasion for the mutual bestowal of presents. Each maiden in turn accompanies her partner out of the apartment, and there the exchange of gifts is made. Among the Indians themselves rifles, horses, and what not enter into this part of the programme. We quickly rummaged our pockets to see if each could muster up some trivial, attractive gewgaw to offer to our respective partners. Here again I was so unfortunate as to be selected as the pioneer of our party. I escorted my partner to the exterior of the shack, and there presented her with a cheap brooch tie-pin which I had been carrying in my vest-pocket. In return she pressed a piece of paper into my hand. We both made our reappearance, the young Indian lady highly pleased with her specimen of Brummagem jewellery, while I made a sly peep into my half-opened hand to see what I had obtained in exchange. To my surprise it was a 5-dollar note! A cheap little piece of jewellery for a sovereign? That was not a bad deal, and I can assure you that my companions were backward no longer. Searching pockets for little pieces of cheap jewellery was industrious and thorough."

But such interludes to the surveyor and his little party are few and far between. For the most part it is hard, unremitting toil, bristling with perils, to which those of an explorer are insignificant, demanding thoroughness in the execution as millions of money depend upon the outcome.

But the industry and privations suffered by the surveying engineers will meet their reward in the interests of commerce. The expresses of the Grand Trunk Pacific will be able to rattle through the formidable Rocky Mountains at the same speed as they can hurtle over the prairies, a result which is certain to spell success.

There is one man whose identification with this remarkable achievement will never be obliterated. It will cling to him day and night through his life. Earl Grey, in an after-dinner speech, made a reference to the future of this railway, and paid a compliment to those who had been associated with the planning of the enterprise. "But there is one man," he remarked, "to whom I think four-tenths of the credit is due." This sly allusion to Mr. Van Arsdoll and the grade at once appealed to the guests, and straightway the engineer responsible for the survey of the line west of Edmonton was nicknamed "Four-tenths Van," and as such he is known among the railway men from Winnipeg to the Pacific Coast to-day.

CHAPTER XIII

PREPARING FOR THE ATTACK ON THE ROCKY MOUNTAINS

WOLF CREEK is the official starting-point of the Mountain Division, and receives its name from the little stream which empties into the MacLeod River at this point. The latter was selected as a natural dividing point, because the prairie rolling all the way from Winnipeg, which, after Edmonton is passed, becomes slightly more undulating, here comes to an abrupt termination, the configuration of the country changing with startling suddenness. This feature, by the way, is characteristic of Canada, which is essentially a country of vivid contrasts. The creek is the only intimation to the traveller that he has left the prairie behind, inasmuch as there is no further indication of the fact. Even the station gives no clue, since it is called Thornton.

From this point the Rocky Mountains are visible, their eternally white snow-caps scintillating with ice like fleecy clouds floating in the sky. Looking to the south the range assumes a very threatening aspect, the jagged crests thickly massed together towering high into the air, and offering a solid resistance to penetration. But as the eye travels along this rugged horizon in a sweep to the west, the barrier is observed to taper away very rapidly, as well as opening up, as it were, with wider and wider gaps occurring between the pinnacles, which themselves do not appear to rise to such altitudes. As the bird flies the tumbled phalanx of granite to the south is perhaps 40 or 60 miles distant, but the railway traverses a matter of

70 miles or more before it enters the range, the line and mountain barrier respectively forming the two sides of a triangle, the apex of which is at Prairie Creek, under the shadow of Folding Mountain, the outermost foot-hill of the range.

The country between Wolf Creek and the gateway to the Rockies is broken up extensively by the meandering waterways and low hills which rise up in regular sequence, to culminate in the " Divide," a ridge forming the watershed of the MacLeod and Athabaska Rivers, to cross which the traveller afoot has to toil, as I did, over a fearsome trail to a height of nearly 4650 feet, though the line makes an easier crossing some miles to the north. When Prairie Creek is gained the foot-hills sheer up like a formidable wall, and are exceptionally steep on the eastern face, being in places almost perpendicular cliffs.

In pushing forward from Wolf Creek the constructional engineers were handicapped severely by the difficulties confronting the forwarding of supplies and provisions. Construction was carried out at various places along a section of 100 miles, and the camps were strung out in an attenuated line at intervals of $1\frac{1}{2}$ to 2 miles. Every ounce of material had to be dispatched from one end, as it was impossible to send it to various points along the line, owing to complete absence of transportation facilities. Edmonton became the base of operations and transport had to be maintained over the slender, thin line of communication stretching for 123 miles between the capital of Alberta and the end of steel.

The contract for the first section of the Mountain Division aggregated 170 miles, and comprised the subjugation of the Rockies, the opposite end being Tête Jaune Cache, on the western slopes of the range, nestling on the banks of the Fraser, in the valley which divides the Rockies from the Selkirks. It was absolutely impossible to attempt forwarding supplies or to commence construction from that

end, inasmuch as it was 540 miles from the nearest available point on the western side of the mountains. Consequently the advance was relatively slow. Even then for several months it was only possible to forward material by rail so far as Wolf Creek, as the progress of the steel was interrupted by the building of two large bridges, aggregating 1200 feet, within half a mile ; and here again the first had to be completed to permit the advance of trains before the second could be commenced.

Grading, however, was continued at several points along the succeeding 100 miles, and as these camps housed large numbers of men demanding provisions and a thousand and one other necessities, the organisation that had to be elaborated to keep the front well supplied would have done justice to an army advancing through hostile country. Long trains laden to their utmost capacity with all sorts and conditions of goods, from canned fruits to posts and wire for fencing ; from rice to cumbersome sections of steel for bridges ; from pork and beans to horses and mules, crawled westwards from Edmonton to the end of steel continuously. I travelled to the rail-head in this wise, and it was a painful, though unique, experience. The train was the oddest assortment of vehicles that was ever coupled to a locomotive, and as the line was in its skeleton form, i.e. had not been ballasted, the train rocked and rolled like a vessel minus its bilge keels. At every mile or so we pulled up to discharge some freight or other at an intermediate point. At times the train slowed down to permit of posts and wire for fencing being tumbled out pell-mell along the permanent way.

At Wabamun Lake there was a halt for the midday meal. While the driver and crew of the train refreshed the inner man some of our party beguiled the tedium of the delay by fishing, and succeeded in landing some magnificent specimens of whitefish, which formed an appetising dish when our journey was resumed, and offered some com-

pensation for the pause in our journey. Now and again there would be a stop, and the clang, clang of hammers and vituperations from men wrestling with the internals of the locomotive testified that something had gone wrong with our steed. Never once did the speed of the train rise above 8 miles an hour, and to cover 123 miles occupied 36 hours! That train was the joke of the little colony assembled round the end of steel, and was promptly nicknamed "The Flier." It was fortunate for us that the driver was not smitten suddenly with the speed mania, for I am afraid that disaster would have been swift and sudden on that rude track.

When the end of steel was gained there was bustle and animation on every side, for the contents of the cars had to be sorted out and dispatched to their respective destinations without delay. From morning to night waggons of all descriptions streamed out of the little town, hurrying the material to the various camps ahead. Everything had to be dispatched by the waggon road, a tedious and exacting operation, under animal haulage, entailing grim fights with treacherous muskeg, slippery rock, and turbulent creeks every few hundred yards. As we toiled along the waggon road on the back of a pack-horse, we were jostled into the bush every few minutes by a waggon as it came lumbering along as fast as its ungainly gait, weight, and the conditions of the road surface would permit. The drivers or freighters paused for nothing. They were working at a low, cut-throat wage of a few halfpence per pound, and the greater the number of miles they could crowd into a day the more they could earn.

It speaks volumes for the organisation that planned the transport of material over such a distance and against such odds that never once did a breakdown occur. There was too careful attention to detail to permit this contingency. Now and again a locomotive would be derailed and a few precious hours be lost, but allowance was made for such

contingencies, so that it did not affect the transport machine to a pronounced degree. Every now and again, as we plodded along the trail we met grim evidences of the penalty paid by the freighters in their mad haste in the form of the bleached carcase of some animal which had come to grief on the journey, and meeting with an irreparable injury, had been shot summarily. Some of the vehicles were hauled by oxen, and though these brutes were slow, their great strength enabled them to cope with difficulties in the mud-holes and muskeg where the horse or mule would have been hopeless. Besides, as one freighter sagely remarked, "oxen are the better investments, for if one has a fall and meets with an injury compelling slaughter, it can provide us with some fresh meat for a few days."

Impatient critics time after time have assailed the slow advance in constructional work on the Mountain Division, and comparisons odious to this particular undertaking have been drawn freely. But their hostility betrayed their ignorance of the true state of affairs, and of the galling difficulties that confronted the builders at every turn. As the mountains were approached the resistance of Nature became sterner and sterner. The rail was pushed through an entirely new and unknown country, where transportation was in its infancy, where the forest and mountain-side were trackless, and where the rivers cannot be equalled in turbulency. Had those critics who talked so glibly visited the front and thus gained a first-hand, face-to-face impression of the obstacles that reared up at every foot advance, and which had to be broken down by sheer physical effort or ingenuity, they would have told a different story, and marvelled not at the slow pace that was made, but at the fact that progress was made at all.

Before a single waggon-load could be sent out of Wolf Creek a waggon road had to be blazed through the forest. The contractor informed me that this would have to be done for 170 or more miles, in order to gain Tête Jaune

Cache, and by the time the latter point was reached over $200,000, or £40,000, would have been expended in this essential preliminary operation, for a road cannot be driven through such country as this for less than $1000, or £200, a mile. It was not merely a matter of cutting a swathe so many feet in width through the thick bush—such was an easy task to men expert with the axe. But the pathway as cleared was impassable to a road vehicle, so other gangs followed on their tracks with picks, shovels, ploughs, and other handy tools, together with adequate supplies of horses to ease banks, level off humps, and to fill depressions, in order that the task imposed upon the freighting teams might be reduced appreciably. Where stretches of muskeg were encountered these had to be "fixed" by means of a corduroy bridge of sufficient strength to support the weight of the cumbrous laden vehicles.

The rivers occasioned many anxious moments. Small creeks could be forded or bridged upon the corduroy principle, but such waterways as the MacLeod and Athabaska offered different problems, as these rivers are wide and run swiftly, in addition to bringing down considerable flotsam and jetsam in the form of trees and other debris. The only means of crossing was by ferry, and these had to be installed. They are simple devices, there being an overhead trolley to guide the ungainly rectangular vessel across the stream, propulsion being provided by the current of the river. Yet their installation cost from £3000 to £5000, since all material had to be brought up by waggon to the site. The ferry across the Athabaska at the Roche Miette was a troublesome undertaking. The river describes a sudden swinging bend, the foot of the mountain thrusting itself into the waterway. A waggon-road over the mountain shoulder following the trail was impossible, so the opposite side of the river had to be gained. The ferry was erected with considerable difficulty, after much exasperating

delay, especially in regard to the heavier and bulkier material, which had to be teamed in over 100 miles. But the river has an ugly current, and before the ferry was brought into full working order there was an accident which wrought considerable damage, the boat being torn away from the overhead trolley line by the velocity of the current and wrecked.

As the waggon road advanced the camps were established at intervals for the accommodation of the workmen. The railway-builders' camp of to-day is vastly different from the tumble-down shacks which sufficed as the navvy's home in the wilderness in the early railway days of North America. Now they are substantial buildings of logs, chinked with moss to secure warmth and cosiness during the winter. The camp-builders followed hard on the heels of the waggon-road builder, and in some instances were ahead of the latter. They selected a suitable site near an ample supply of fresh water, cleared a large area, and with trees felled in the vicinity erected the temporary homes. This task alone involved an outlay varying from $3000 to $6000—from £600 to £1200, according to the importance of the camp and the number of men it was designed to accommodate.

At Prairie Creek the constructional engineers provided a hospital. It was a roomy building built of logs, divided into two wards, each of which contained fifteen beds, and was fitted with every convenience. The dispensary was likewise commodious and well stocked, while the operating theatre, a small apartment, was finished off in white American cloth to facilitate sterilisation and cleaning. I have been in hospitals situate in the midst of teeming cities, and yet have seen none to compare in point of equipment with that over which I was shown in the heart of the wilds on the banks of the Athabaska at Prairie Creek. It was a strange blend of civilisation and primevalism; an incongruous setting in the frame of wilderness, thrown into

A Railway Construction Camp

A large clearing is made in the woods, the felled trees being utilised for building roomy log-shacks for the graders as well as câches for provision and barns for fodder. The establishment of such a small community as this costs from $5000 to $6000, or £1000 to £1200, for the buildings alone.

stronger relief at the time of my visit by the Indian encampment on the opposite side of the noble waterway.

When the camps were completed the most important phase of the operations necessary for the furtherance of the grade were taken in hand. This was the provisioning of each camp with a sufficiency and variety of supplies for the needs of the navvies. Toiling in the virgin purity of Canada's western atmosphere at an altitude of some 2500 feet above sea-level provoked Gargantuan appetites, while the prospect of the camp being buried in the steel grip of winter for some five or six months necessitated catering for emergencies. There were about fifty camps scattered between Wolf Creek and Jasper Park, a distance of about 90 miles, in addition to roomy caches packed from ground to roof with every imaginable description of food-stuffs and merchandise in demand by the men engaged on the grade. Yet the establishment of these camps had involved an outlay of between $2,000,000 and $4,000,000, or from £400,000 to £800,000, before a sod was turned. The caches on this stretch alone were stocked with provisions and supplies valued at over $1,000,000, or £200,000, at the time that I made my way along the grade.

But although the summer afforded a glimpse of extraordinary bustle and the woods echoed with stentorian cries, sadly out of place in the silent wilderness, as the freighters strained every nerve to reap the utmost obtainable by freighting goods at 2½d. per pound over a crude road 120 miles in length, it was during winter that the greatest animation prevailed. So soon as the snow had enveloped the ground in its white mantle and the surfaces of the turbulent rivers were sheathed in a thick, glassy armour, scores of sleighs were fashioned and hundreds of horses and mules were pressed into service in an endless stream. They sped over the crisp, crackling snow trail connecting the camps in a continuous chain, the toboggans

being laden to creaking point with piles of supplies. The work was hard and incessant, for snow transportation is the cheapest method of conveyance in a country where no railway exists, and the horses can make a merry pace over the packed, even surface. The jingle of bells broke the solitude of the whitened country, and the drivers, encased in their thick furs, laughed heartily and merrily, in striking contrast to their summer sullen demeanour, as they swept along, for although the freighting rate was lower than by team and waggon, the money was more easily earned.

The toboggans were packed to a dangerous extent, for the amount of goods that had to be freighted in while the snow held the ground ran into thousands of tons. One winter over 30,000 tons were transported to the various camps from the end of steel within a very short time. And these gliding vehicles carried everything and anything. This was packed with bales of hay to a height that threatened to capsize the vehicle, for every camp possessed a capacious barn stocked with immense reserves of fodder for the animals engaged on the grade ; that bore cases of tinned comestibles ; another was charged with clothes, boots, shirts, and what not for the stores ; a fourth was laden with nothing but flour ; while others transported huge baulks of timber or sections of steel-work, and so on. The two streams of traffic, the outgoing laden and the incoming empty, poured up and down the winter trail like the endless belt of a conveyor, and the vehicles followed so closely together that one travelling over the road on snow-shoes was scarcely ever out of sight of a sleigh.

At times the heroic was attempted, despite the exceptional difficulties with which it bristled. When I gained a remote point along the grade, I was surprised to find a big locomotive and dozens of trucks busy at work dumping the spoil that was being removed by two huge steam-shovels. How did they get there ? The train could not have run in under its own power, for the end of steel was

some 28 miles to the rear, and the road was broken by yawning gulfs where rivers waited to be spanned. Nor could it have come by road. Reflection upon the troubles of the primitive highway, with its stretches of swamp which would have sucked down once and for all such a weight as a locomotive had it been caught in its terrible embrace, convinced me that such was not its means of entry. I was somewhat puzzled until, seated round the blazing camp fire at night, the engineer volunteered an explanation. It had come in by road, but it was over a road of snow, and its vehicle of transportation was a crude platform carried on runners.

When the mountain section was commenced, the constructional engineers realised that the advance of the steel beyond Wolf Creek would be delayed for an indefinite period. In addition to the two big bridges that were to be built over the Wolf Creek and MacLeod River, a huge timber trestle, over half a mile in length, was planned across Sun Dance Creek, at the Big Eddy about 16 miles west of the MacLeod River. But 10 miles beyond this trestle there was a heavy piece of excavation through the hump of a hill, and to cope with this a steam shovel, locomotive, and trucks were imperative. If they waited until the steel reached this point, progress would be delayed a considerable time until the cutting was pierced. Therefore the builders decided upon a bold expedient.

The winter had scarcely gripped the country when one day an engine, hauling a train of ballast trucks and two steam-shovels, steamed to the end of steel. Within a short time gangs of men were swarming over the 60-ton locomotive, knocking it to pieces, while other gangs were treating the trucks and steam-shovels similarly. As the train was dismembered the parts were laden up on special sleighs, and within a few days a sight strange even to the Far West, the land of curious spectacles, was to be seen. Hundreds of mules and horses were pulling and tugging at

a train of flat decks mounted on runners piled up with wheels, rails, and other odds and ends. The boiler of the locomotive was shored up on one large toboggan and its tender on another, each being hauled by a score or so of horses. The train—lock, stock, and barrel—was being transported 28 miles across country! Upon arrival at the big cut the gangs of mechanics retrieved the numbered pieces of the various trucks, engine, and steam-shovels, and were soon hard at work resetting them in their original places. Before long steam was raised, and the engine puffed along the short length of track that had meanwhile been laid down, while the steam shovel swung its jib and devoured mouthfuls of spoil. The men on that cut were proud of their handiwork, for, as they acknowledged, it was "a pretty tough proposition." When I arrived the hill was being demolished with a rapidity that augured well for the completion of the cut by the time the track-layer crossed Sun Dance Creek.

The camp facilities included a temporary telephone wire, which trailed through the woods linking up each camp, and all business was transacted by this method of communication. Every camp, when fully stocked, carried supplies sufficient to tide the men over nine months, so that the possibility of their being reduced to short rations was remote in the extreme, for no breakdown in the line of communication would have been beyond repair within that space of time.

Railway-building amidst such formidable mountains as the Rockies is certainly exceedingly expensive when it entails the laying out of something like a million sterling to prepare the ground for the navvies upon a mere stretch of less than 100 miles! And, moreover, it is a phase of engineering where losses can be incurred so easily and to such an extent as to bring swift disaster. It calls for a guiding spirit possessed of abundant determination, resource, and to the manner born in organisation and the

handling of men. In this particular instance the enterprise was controlled by one, Mr. J. W. Stewart, who has spent the greater part of his life in railway-building among the mountains of America. He gained his first impressions of the tremendous difficulties surrounding such tasks when attached to a survey party that planned the path through the mountains of British Columbia for the first Canadian trans-continental railway. Subsequently he built a short length of the road, the plotting of which had entailed such labour, and from that point proceeded to larger and larger mountain railway engineering undertakings, each with conspicuous success. This unique experience, spread over some thirty years, had familiarised him with the peculiar conditions attending such work, with the result that he faced the construction of 300 miles of line through the most difficult and broken country with as much confidence as he assumed the building of a line across the level prairie. As he confessed to me : " It is merely a question of organisation—the technical difficulties of construction are of minor importance. But one must have men ; and they must be fed, housed, and equipped with tools ; ready for any class of work that may confront them."

CHAPTER XIV

BUILDING THE LINE THROUGH THE ROCKY MOUNTAINS

IT was when the railway crossed the MacLeod River that construction commenced in grim earnest. At this point the grade is at an altitude of 2855 feet, yet to traverse the mountains it rises only a further 868 feet at the Yellowhead Pass, this ascent being overcome in about 130 miles. The profile of the grade between the two points is a steady, almost continuous climb. Seeing that the Yellowhead Pass marks the summit level of the line, such a slight ascent is remarkable.

Proceeding westwards from Wolf Creek the line clings to the hill-tops, which roll away like waves to the foot-hills of the Rockies. For the most part these ridges are threaded by the MacLeod River, the slopes tumbling down almost perpendicularly into the water. The result is somewhat startling. The builders have resorted extensively to side-hill excavation on the brow, so that the line is laid upon a narrow shelf, and from the track one has a view of a sheer drop of 200 feet or so into the river ambling along below. The crests of these hills were blown away in large masses by the aid of dynamite, the spoil not required for filling depressions being sent with a rattle and a roar down the cliff face—an economical method for disposing of excavated material for which there was no utility. As I picked my way along the grade, which could be followed easily by the location stakes and the tracks of the clearers, who had cut the right of way for the ribbon of steel, I happened upon isolated gangs of navvies working in little pits.

At first sight one might have thought they were merely quarrying for the stone, as the huge blocks were torn and prised out to a depth of 15, 20, or 30 feet, but when one examined more closely, it was to be seen that the galleries were being driven right and left, and at places they had met, leaving a hollowed-out passage-way 20 feet wide to form the bed for the pair of rails. Although the country is broken extensively, it was found possible to select a suitable location involving the minimum of heavy steel bridge-work. After leaving the MacLeod River there is not another heavy metal bridge for 72 miles, when Prairie Creek has to be spanned by a structure 800 feet in length. Then there is another free run of about 30 miles before the Athabaska is crossed by a massive structure which is one of the longest and largest works of this class on the whole line.

For mile after mile progress was somewhat slow, as the rock proved hard, and could not be displaced without recourse to the disintegrating forces of dynamite and black powder. Boxes of this agent and lengths of wire trailed on all sides, and now and again one saw a puff of dust and smoke, with a stream of massive boulders hurtling down the cliff face, as the rock-hogs tore their way forward relentlessly.

Such work is typical throughout the whole of the mountain section, and the rate of advance varied according to the character of the soil encountered. Solid hard rock gave way in turn to sand, gravel, and muskeg. The last-named was perhaps the most uninviting material with which the navvies were brought face to face. It is a vicious, slimy substance, and the excavators were bespattered from head to foot like mud-larks. As they ploughed their way through the mass a miniature lake formed in their rear due to the water draining out of the bog on either hand, and accumulating in the depression until the hump was pierced at last and an outlet formed for the imprisoned water, which went rushing and tumbling into a creek or river.

The specifications concerning the work were drawn up on stringent lines. In cuttings the sides have a slope of 1½ to 1 where earth is encountered ; 1 to 1 in regard to loose rock ; and ¼ to 1 through solid rock. The width of the cut at sub-grade level, that is the level ready for the receipt of ballast, is 22 feet through earth, and 20 feet through rock. In regard to embankments the slope on either hand is 1½ to 1 for earth, and 1 to 1 in rock, by 16 feet wide at sub-grade level when the embankment is less than 16 feet high, increased to 18 feet in width when the earthwork exceeds the latter height.

The preliminary task of clearing was to a great extent performed under contract, which system proved the most expeditious, but where this was impossible the clearers as a rule received $40, or £8, per acre, which approximated about 400 feet run of right-of-way. This wage, it may be mentioned, was inclusive of living. The timber as felled was piled up and destroyed, except such as might be deemed useful for other purposes. If any felling outside the prescribed width of the right-of-way became necessary, if, for instance, the list of a tree proved dangerous to the safety of the railway, it had to be removed, the men being paid so much per tree for this extra cutting. After the trees had been felled the stumps had to be removed and destroyed similarly, the contract price for clearing invariably including the subsequent operation of grubbing.

This task had to be carried out with a certain amount of care, because of the danger of creating forest fires of a highly ruinous character, and as Canada's loss per annum from this cause represents a huge figure every year, no effort was spared to reduce this damage from the clearing of the right-of-way. Owing to the precautions observed, conflagrations among the forests attributable to the railway clearers were practically nil, though at times, as I saw, the standing trees on either hand had run a very narrow escape, for the dry dead-fall when fired flared like shavings.

Here and there the builders were confronted by tremendous difficulties, such as in the vicinity of Brûlé Lake, at the entrance to the Rockies. This sheet of water is in reality an enlargement of the Athabaska River, the southern bank being deeply indented, and the soil a light sand. The railway skirts the southern bank, and in order to preserve the grade, heavy embankment work was requisite. The remarkable feature of this sheet of water is that it is always swept by a wind which at times assumes the fury of a gale. Even at the time of my arrival in midsummer, when the air a few hundred yards inland was oppressively still, a keen breeze played across this lake. This peculiarity is attributed to the fact that the expanse lies in the path of the funnel formed by the passage of the river through the mountains, and through this constricted channel the wind is forced to make its way like a huge draught, to expend its force upon this area of water. Be that as it may, its existence resulted in a pretty battle between Nature and the engineers, and the struggle for supremacy lasted a long time.

As fast as the sand was excavated from a cutting and dumped to form an embankment, it was picked up by the wind and driven back again. On this short length of line around the lake there are two notable pieces of work, a cutting from which 87,000 cubic yards were removed, and an embankment built up of 117,000 cubic yards. The broad, high surface of the latter suffered from the full force of the wind, which picked up the sand in dense clouds and drove it irresistibly forward into the cut. At last the engineers erected a series of screens which deflected the eddying, circling wind laden with dust, the latter falling helplessly against these obstructions, and in time forming a natural protection to the cutting. So far as the slope of the embankment was concerned, the expedient of protecting its surface with scrub was adopted and found to be highly successful.

The broken character of the country, especially in the immediate vicinity of the mountains, necessitated considerable excavation, and the fills where the removed spoil could be used to advantage often entailed a relatively long haul. The excavators were compelled to carry the spoil over a distance of 500 feet free, in accordance with the terms of the contract ; when it became necessary to exceed the limit of this free haulage extra payment was awarded on the basis of 1 cent—½d.—per cubic yard for every additional 100 feet, up to a total haul of 900 feet from the site of the excavation.

Occasionally bad stretches of muskeg were encountered, which, from their low-lying situation, could not be drained effectively, while the depth of the swamp militated against the formation of a solid embankment. From foundation-level in such cases corduroying or " cross-waying " had to be resorted to, as already mentioned, the earthwork superstructure being supported on a sunken mattress. The latter was built up of logs not less than 6 inches in diameter to a depth of 12 inches. On the top of this structure brush and branches were laced, to form a kind of thatching, and carried to a thickness of at least 18 inches, so that the full depth of the mattress was some 2 feet 6 inches. Occasionally circumstances demanded the construction of a more substantial foundation of this character, some of these mattresses attaining formidable proportions and standing 5 feet in height, when laid in position on the surface of the morass. The mattress was then sunk into the unstable soil by superimposed stone and earthen embankment, and immersed completely in water, where in course of time it will be transformed into a solid and substantial plinth, as the wood becomes water-logged thoroughly.

Trestling had to be resorted to in order to bridge depressions of such great depth and width as could not be spanned quickly by embankment. Sun Dance Creek, at the point where it flows into the MacLeod River, had to be

APPROACHING THE MAIN RANGE OF THE ROCKY MOUNTAINS

This photograph, taken from the Roche Miette, shows Jasper Lake, one of the most beautiful sheets of water in the mountains, the Athabaska River to the right, and the turbulent Rocky River feeding the latter from the left.

crossed in this manner, the requisite structure entailing the erection of a network of timber half a mile in length by 125 feet in height at the centre, whereas the creek itself is an insignificant brook barely 20 feet across. In the centre the trestle is composed of five tiers, each 25 feet in height, and it constitutes one of the largest works of this character on the mountain division. In due course, however, the rivulet is to be provided with a substantial bridge carried out in ferro-concrete or steel, and the maze of timber-work on either side then will disappear beneath a massive pile of earth. In another instance, owing to two large sheets of water obstructing the progress of the line, the former were first emptied, and a trestle and earthen embankment erected upon the exposed water-bed.

One of the engineers related an amusing experience that befell a party working on a section of the line running through the great national Game Preserve, extending over 5000 square miles, and known as Jasper Park. The line traversed a belt of swampy ground, and investigation revealed the fact that it was a beaver colony, the industrious engineers of Nature having erected a dam so substantial in character as to defy destruction except by the aid of dynamite. The grade had to be carried across one end of their pond, and instructions were issued that the animals were to be disturbed no more than was absolutely necessary. After lowering the beavers' lake by making an insignificant breach, the workmen set to work to prepare the foundations for the grade within the area of the pond, secure in their safety. One morning, to their great dismay, they observed the water to be rising suddenly. Discarding their tools, they beat a hurried retreat, and within a very short time the enclosure was filled with water to its original level.

Somewhat puzzled, the workmen made an investigation, and found that the beavers had detected the breach that had been made in their structure, and had promptly

repaired it. Directly the outflow was checked the pond filled up very quickly, since it was fed by a creek. The navvies made another break in the wall and resumed work, only to be driven from their work once more a few days later. Time after time they were flooded out in this manner, for the animals always succeeded in discovering the cause of the water around their home falling below the critical level, from their point of view, and although the workmen, in their desire not to frighten the beavers away, resorted to extreme cunning in effecting a breach, it fell far below the intelligence of the animals in repairing the injury. Still the men completed their task without openly breaking up the beaver's retreat, though they were well-nigh driven to do so at times.

Once the foot-hills were passed and the main range was entered advance became slower, for at times it was by dynamite only that the railway could make its way. The Roche Miette necessitated some heavy work of this character, for the toe of the mountain drops sheer into the Athabaska, which is forced somewhat out of its course by the interruption of the mass of rock, and consequently describes a sharp bend. The cliff face is about 80 to 100 feet high, and the railway was plotted along this wall about 10 feet above high-water mark. To cut the requisite shelf to carry the pair of metals, thousands of tons of rock had to be blasted out, and the spoil thus removed was dumped into the river to build up the embankment. The force of the water at this point is tremendous at times, for when in flood the Athabaska rushes round this bend at about ten miles an hour, while the sudden deviation of the current sets up such heavy scouring as to threaten to wash the embankment away. But the navvies dumped the rock overboard in such solid masses as to defy their removal by the fiercest of water, and the embankment created is as solid as the mountain rearing up sheer on the one hand.

After the Roche Miette is passed a water-logged valley riven by the numerous channels of the Rocky River extends for several miles, followed by earthwork through sand alongside Jasper Lake, and then the line sweeps suddenly across the waterway, the southern bank of which is hemmed in by the Colin Mountains, which form an almost perpendicular wall towering to a height of several hundred feet. To cross the river, which at this point is about 600 feet wide, a massive, lofty steel bridge was necessary ; but when the northern bank was gained there existed a gently undulating bench along the centre of which the locating engineers planted their stakes, and in such a manner as to ensure an almost straight line for a few miles. Then the grade describes a wide sweep and enters the Miette River Valley. This is a narrow ravine, no more than a mere cleft, with the mountain-sides sloping down to the water's edge at an angle of about 60 degrees and broken to an extreme degree. Here the builders are being forced high up on the hill-side, both to secure the grade and to facilitate construction, for the river falls very sharply into the Athabaska.

The rock for the most part is a slippery shale associated with limestone, and at places the cost per mile is proving exceedingly costly. Evidences of heavy rock-slides and landslips are to be seen on every hand, and the skill with which the locating engineers have avoided these direful visitations is a striking tribute to the thorough manner in which the survey was effected. At places, owing to the spurs of the mountains jutting right out to the water's edge, Herculean work is necessary to hew a gallery 20 feet in width for the ribbon of steel. As the valley is penetrated the mountains crowd closer and closer together, and the surveyor was hard put to it to plot a foothold at an economical outlay. The Miette River in its upper reaches becomes broken up into a number of channels, inasmuch as the configuration of the country does not

permit the water to pour its full volume through a single passage. Then, just when the outlook assumes its most threatening aspect, the line swings across the river and attains its highest altitude or summit—the Yellowhead Pass.

At this point, where the line "passes" from Alberta into British Columbia, the mountains roll back, leaving a broad defile a thousand feet or so in width. It is a natural portal through the mountains, and has given the Grand Trunk Pacific Railway an advantage of which they cannot be deprived by any manner of means. The bench mark alongside the location indicating the summit level records the altitude at 3723 feet. The rail level will be 3 feet lower, and this will be the highest point to which the trains will have to struggle on their long journey of 3543 miles from the Atlantic to the Pacific.

To comprehend the advantage the Grand Trunk Pacific possesses in this strategical pathway it is necessary to recall the heights to which other competing lines crossing the selfsame range have to toil in order to gain the coast. First of all, however, it must be pointed out that this is the only mountain range which has to be negotiated by the Grand Trunk Pacific, owing to the marvellous manner in which the Cascades—possibly a more fearsome mountain barrier to the engineer—have been threaded, and which is related in a subsequent chapter. The following table illustrates the severe struggle which is imposed upon the trains of the North American trans-continental railways in order to overcome the mountains, and how great is the advantage possessed by the Grand Trunk Pacific in point of grades and low summit elevation. It will be observed that the early railways have to toil to extreme heights, and, moreover, have to negotiate two or three summits to gain their objectives; whereas the new Canadian line has but one solitary summit to surmount. Moreover, it will be seen that its nearest competitor, the Western

Pacific, which, like its Canadian rival, is a recent undertaking, wherein the accumulation of experience has been brought into effective utilisation, has a maximum grade twice as heavy as that secured via the Yellowhead Pass.

Name of Railway.	Summit Altitudes.	Maximum Gradient per Mile. West-bound.	East-bound.
Canadian Pacific . .	2 summits . 5321 feet . 4351 ,, .	116 feet ...	118 feet
Great Northern (U.S.A.)	3 summits . 5202 feet . 4146 ,, . 3375 ,, .	116 feet ...	116 feet
Northern Pacific (U.S.A.)	3 summits . 5569 feet . 5532 ,, . 2849 ,, .	116 feet ...	116 feet
Union Pacific (U.S.A.) (Omaha to San Francisco)	3 summits . 8247 feet . 8017 ,, . 5631 ,, .	105 feet ...	116 feet
Western Pacific (U.S.A.) (Salt Lake City to San Francisco) . . .	2 summits . 5712 feet . 5018 ,, .	53 feet ...	53 feet
Chicago, Milwaukee, and Puget Sound (Missouri River to Seattle) . .	3 summits . 6350 feet . 4160 ,, .	89 feet ...	105 feet
Grand Trunk Pacific (Winnipeg to Prince Rupert) . . .	..... 1 summit . 3720 feet .	26 feet ...	21 feet

The insignificant grades of the Grand Trunk Pacific are thrown into stronger relief by comparison with those existent on other lines. But it means much more from the operating point of view. The train which can hurtle over the gently undulating prairie at 40 miles an hour will be able to rattle through the mountains without diminishing its speed a fraction—the Rockies have been made as level and as seductive a galloping ground as the 793 miles run from Winnipeg to Edmonton. Such a feat is unparalleled in railway history in North America, and

the outlook for this new all-red route is overwhelmingly attractive. Rate wars may be avoided by the arrangement of tariffs, but the Grand Trunk Pacific will always be in the position to dictate terms, for its operation must prove profitable at a figure which would spell financial disaster to rivals.

The point has been raised often why this obvious pathway through the mountains for the iron road has not been seized previously. As a matter of fact, if the counsels of men who knew had been followed some twenty-five years ago coast-to-coast railway traffic would have moved via the Yellowhead Pass. It was the highway for centuries of the Indians travelling between the interior of the Dominion and the coast—their trail beaten down by millions of feet can be seen to this day—but the white man refused to profit from the Red Man, who followed this route purely from instinct. True, the adoption of this route has robbed the construction of the Grand Trunk Pacific of spectacular engineering achievements. One looks in vain for those wonderful loops and spirals by which other lines ascend and descend the mountain chains. Yet the most impressive feature about this railway is the fact that it crosses the awe-inspiring Rocky Mountains at a lower altitude and with a greater ease than many other competitive lines span the rolling desert, and that without recourse to prodigious, costly, or picturesque work. The engineers merely profited from physical conditions : seized the path that Nature had provided as if in anticipation of the birth of the railway—that is all.

To show how sharply the Miette River falls to meet the Athabaska River, the difference in altitude between the Pass and the junction of the two rivers is 400 feet, while the distance is 17 miles—a drop of about 23½ feet per mile. At the entrance to the Miette Valley the railway grade is at a point high above the river, whereas when it crosses the waterway to enter the pass it is at surface-level.

The skill with which the Grand Trunk Pacific surveyors found a route via this pass, with grades not exceeding 21 feet per mile, receives striking testimony at this point. As originally projected, the Canadian Pacific Railway was to gain the coast by this route. The whole line was surveyed in 1876, and there, standing within easy reach of the Grand Trunk Pacific summit bench mark, I saw that erected by Sir Sandford Fleming, C.M.G., a quarter of a century ago, with the inscription 3723 feet still plainly discernible. Yet the route then plotted gave a heavier line than that which now has been found, being, in fact, one with a ruling grade of 1 per cent—more than twice that of the Grand Trunk Pacific. Making my way a little to one side, I found a third summit bench mark, that of the Canadian Northern Railway, which, following the abandoned Canadian Pacific location for a considerable distance, is racing the Grand Trunk Pacific to the coast. The Canadian Northern Railway, however, is similarly handicapped by a heavier grade, for it shows a maximum rise of 52·8 feet, or 1 per cent, per mile.

Leaving the pass the line makes a gentle descent, and in the course of a few miles meets the "Bad River," as Simon Fraser, the intrepid explorer, called the waterway which bears his name. The constructional engineers, in following its sinuous course, will have a heavy struggle to maintain their grade, for the river falls sharply through nothing but a series of wild canyons bristling with precipitous cliffs on either hand. At places the engineer has been handicapped so heavily that he has had to leap across the waterway to gain a narrow shelf where the preparation of the permanent way can be carried out at an economical figure, and which is just sufficiently wide to carry the pair of metals and no more. The plotting of the line through this gorge to Tête Jaune Cache is a notable piece of survey engineering, owing to the physical conditions and severe limitations at several places. But

although the accepted location was satisfactory, subsequent revisions have enabled the engineers to improve upon a route through country which from its character was deemed impossible of providing a path easier than that discovered with so much difficulty in the first instance.

After threading the mountains for some 30 miles the valley suddenly opens out under the shadow of Mount Robson, the loftiest and most majestic of Canadian mountains rearing its huge ice cap 13,700 feet into the air. Hugging the southern bank of the Fraser, bounded by a lofty perpendicular ice-crowned wall, the line gains the extensive valley forming the head-waters of the Thompson and Canoe Rivers at Tête Jaune Cache, which marks the western entrance to the Rocky Mountains.

CHAPTER XV

AN EMPIRE OF TO-MORROW, AND THE DORMANT RICHES OF NEW BRITISH COLUMBIA

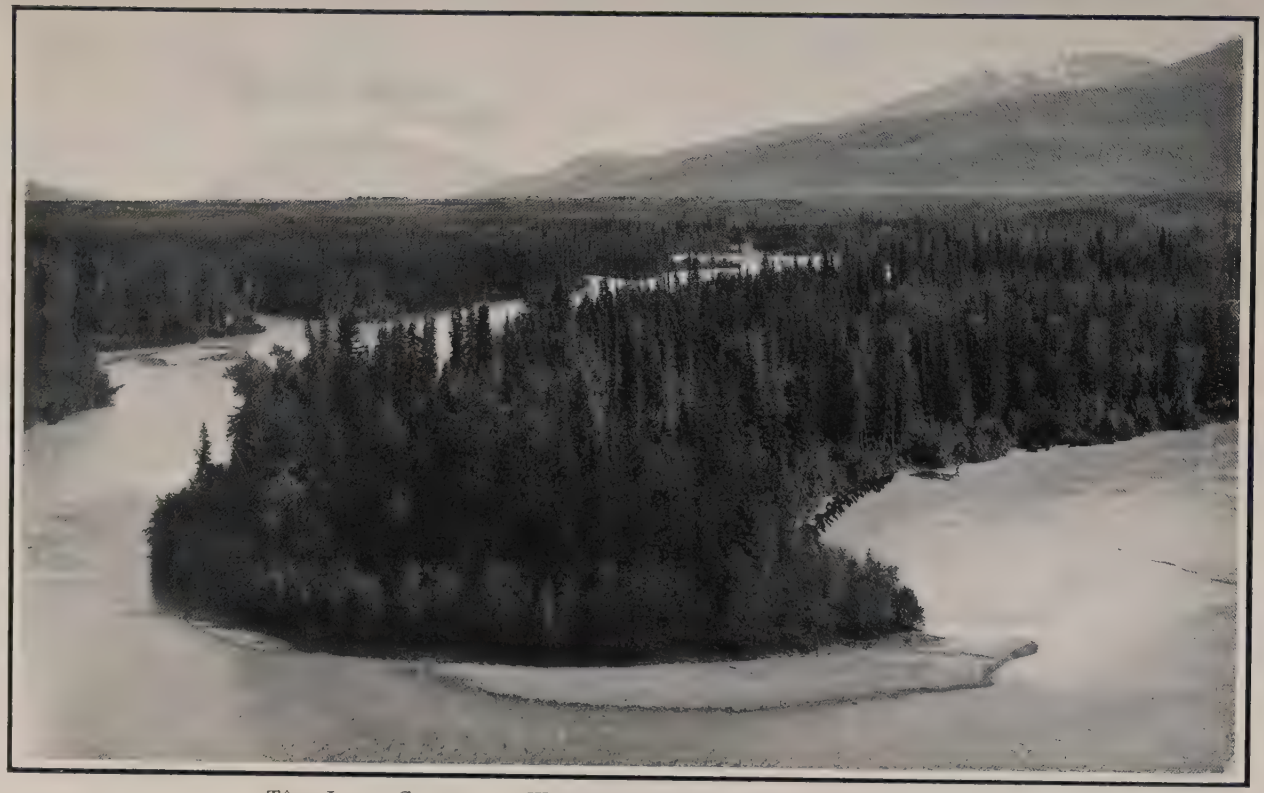
ONE conspicuous advantage accruing from the location of the line through the Yellowhead Pass, and then striking in a north-westerly direction from Tête Jaune Cache, has been the complete avoidance of the Selkirk mountain range. This chain might be described almost as the outer western flank of the Rockies, though it is separated from them by a wide fertile valley extending south-eastwards from Tête Jaune Cache, which carries the Canoe River into the Columbia, some 180 or 200 miles distant. When the valley in which Tête Jaune Cache is is opened up, settlement will spread down this valley rapidly, for it offers great attractions to the farmer. Indeed, this depression amid the tumbled snow-clad peaks is as an oasis in a mighty desert, and the probability is that in the course of a few years a railway will be carried up the Canoe River Valley as far as Tête Jaune Cache, where a junction with the Grand Trunk Pacific will be effected. By this means the interior of New British Columbia will be brought into direct communication with the great railway systems of the Western United States. As a feeder it will be of incalculable value. Such a line, from the information I gathered on the spot, would offer no great constructional difficulties, and could be constructed cheaply, bearing in mind the rugged character of the surrounding country on either side.

From Tête Jaune Cache the Grand Trunk Pacific pos-

sesses what might be described as a clear run through the heart of New British Columbia until the mountains are encountered once more at Aldermere, near the coast. The intervening country is of a diversified character, and construction for 400 miles will be closely analogous to that prevailing in Great Britain, of which, indeed, British Columbia is a replica on a large scale in many ways. The obvious route for 190 miles is through the Upper Fraser River Valley to Fort George, following roughly the course of the waterway, and this is the route that has been chosen.

Until the Grand Trunk Pacific surveyors penetrated this country it was practically a closed book. Scarcely anything was known concerning its topography, its natural resources or possibilities, and even to-day the incoming settler can secure but scanty information to assist him in his conquest of the wilderness. As we travelled down this magnificent waterway the solitude and silence were such as could be felt. For over 320 miles we saw scarcely a vestige of civilisation. Here and there we met a hardy prospector toiling among the creeks and tributary rivers for signs of gold and other minerals, and for the most part their intrepidity was meeting with inspiriting reward. At one or two places signs of embryonic settlement were in evidence, but it required considerable pluck and determination to penetrate and homestead among those tree-bound wastes with the railway over 300 miles away, and the little patches of hay and garden produce were as isolated as if on the planet Mars.

Yet this country is proving another surprise for the railway. The dormant timber wealth alone represents many millions sterling, and for the most part it has escaped the ravages of the forest fire. The valley is of considerable width, and the ground slopes gradually upward from the fringes of the depression to the bases of the mountains which hem in the vale on every hand. The mighty Fraser



TÊTE JAUNE CACHE, THE WESTERN PORTAL TO THE ROCKY MOUNTAINS

This valley is about thirty square miles in area, and forms the headwaters of the Canoe and Thompson rivers. In the foreground is the Fraser River. On the left is Mount Thompson of the Selkirk range. To the right are the Mica Mountains.

rolls from side to side in the most bewildering manner, doubling and redoubling upon itself to an amazing degree. More than once in our paddle down-stream in the dug-out we were called upon to make a huge curve nine miles in length to make barely a mile's advance in an air line. Had we portaged across the chord of the arc we could have saved many miles time after time.

A convincing evidence of this extraordinary winding on the part of the Fraser may be gathered from the fact that the distance by water between Tête Jaune Cache and Fort George is 320 miles. The location of the railway is such that the distance between the two points is reduced to 190 miles, owing to the iron road describing practically a bee-line through the valley. At one place the Fraser is left no less than 22 miles to the south.

The fertility of the belt which the line is threading is astonishing, and the surveyors brought down wondrous stories of the vast wealth merely awaiting the invasion of the hardy settler. Nor is this wealth available only to one ramification of human endeavour. True, the agriculturist has the greatest opportunities, but his efforts towards the development of this inland empire will be assisted by others searching the higher mountain slopes for the minerals buried in their hearts, the lumberjack who will revel in a mass of timber which is to be equalled by few other parts of Canada, and the pulp-wood miller who has ample supplies of raw material here at his very door, with adequate water power on the one hand, and excellent transportation facilities on the other.

The timber at places is among the finest that British Columbia can offer, famous though its resources are in this direction in the exploited areas. Yet the latter represent but the outermost fringe of what is concealed in the interior. For instance, at the present moment the American Continent is suffering from a famine in cedar. The reserves of this commodity in the United States have been well-

nigh depleted. This has hit the lead-pencil trade with particular severity, and the manufacturers, driven to extremities, are to-day pressing the stumps of the trees which they disdained years ago into service. In Eastern Canada the farmers of half a century ago, who cleared the young cedar trees from their settlements and fashioned them into rude fences, are now disposing of the latter at fancy prices.

Yet in the Fraser River Valley are vast cedar groves awaiting the stroke of the axe. During my journey I encountered fallen monarchs of this wood, laid low by fire and wind, running up to six feet in diameter, and which, although in the last stages of decay, afforded evidence of original soundness to the core. The Douglas fir, spruce, balsam, hemlock, and other woods stretched for miles from the water's edge to the slopes of the mountains, while the pine continued the forestation to the limits of vegetation's existence, which is between 6000 and 8000 feet above sea-level. The brilliant colour of the verdure compelled attention, and recalled memories of home, for the climate within this extensive vale is closely similar to that experienced in these islands.

There is every indication that the logging industry will assume gigantic proportions within this country. Down on the coast the lumber mills are experiencing greater and greater difficulty to secure supplies of raw material, but it is only at places along the shore that profitable areas of this valuable product can be found within easy access of the mills. The latter are being forced more and more every succeeding day to penetrate the interior by hook or by crook, often in the face of the gravest danger, to gain their requirements. As the Fraser River opens up, the local demands for lumber for a thousand and one purposes will multiply rapidly, and it must be admitted that in this particular field the immediate future is the most attractive. What the possibilities of this valley are no one can say. But a narrow strip along either bank of the

waterway has been investigated. The forest is too tangled and matted in its primevalism to admit of promiscuous penetration. Consequently the land will have to be cleared systematically and the wall of trees forced back more and more towards the mountains as settlement spreads inland from the banks of the waterway.

I met more than one engineer who had been engaged on the survey through this valley, and who had also been thrown face to face with the wilderness of Northern Ontario in the same quest—the grade for the new railway. But one and all confessed that although the forest of Ontario was dense and jungle-like, it did not compare in character with that found in this region. The trees were more prolific, of greater and more magnificent proportions, and so resistant to attack that the surveyors were compelled to heroic work to drive the lines for their traverses. Their story was supported by the companies of surveyors who were busy at work preparing a land survey for the Government. These men had prosecuted this task in all parts of the province, and consequently were experienced in fathoming the secrets of the forests ; but on this occasion they admitted that they were confronted with a superhuman task, and were only able to carry out their work for a mile or so back on either bank of the river. Beyond that limit was the unknown, and they could afford no idea of what was concealed there, for the sea of massive trees stretching so far as the eye could see guarded its secret tightly.

Yet agriculture will come into its own in this wonderful territory. The soil is piled up to a great depth with decayed vegetation—the accumulation of centuries—and the soil is as black as jet with fertiliser. Yet silt is in abundance, for the depression is cut up in all directions by noble waterways emptying into the Fraser. In times gone by it is very evident that these rivers were of far greater width than they are to-day, and that much of the country which

is now clothed in vegetation was submerged. The soil is water-logged heavily, and the homesteaders will be called upon to carry out simple surface drainage work before they can hope to bring the land to productiveness. That the future of agriculture is rosy the luxuriance of the brush testifies abundantly, for it never could have become so dank, thick, and high were the soil not rich in the essential constituents for the support of vegetable life.

Then mining will claim considerable attention. Far down below Fort George paying traces of gold have been discovered, and efforts are being made to secure this wasting metal by dredging. But it is merely placer gold, though its quantity speaks eloquently of the fact that somewhere or other on the upper stretches of the Fraser rich deposits of the yellow metal must exist. I met hardy prospectors who were following up this yellow trail like sleuth-hounds, confident that they would find the key to this treasure-chest of Nature in due course. One party had met with success on the Beaver River, and were anticipating the arrival of the railway, which would enable them to bring in the requisite machinery to prove or disprove the results of their investigations on their prospects. Another party were scouring among the mountains bordering the Shuswap River, and likewise had attained a certain measure of success, which at that time could not be substantiated or disputed owing to lack of facilities.

The men who found the grade for the railway in this valley experienced abnormal difficulties and faced appalling perils. The only means of entering the country was by the waterway, for the forest on either side is trackless. There is no trail from Tête Jaune Cache to Fort George. The Indian, with his innate knowledge of backwoods transportation, did not attempt to penetrate that fearsome aspect of tree, but took to the water, for the perils of its canyons and rapids were insignificant in comparison with the dangers lurking in the woods, which at present are

the home of the bear, moose, and other big game in abundance.

When they entered the country, a journey involving 320 miles overland to Fort George, they could gain no reliable information whatever. The only highway was the Fraser River, and this entailed a journey of eighteen to twenty-one days, for, owing to the turbulence of the water and the velocity of the current, a boat has to be poled up-stream foot by foot. There is an Indian village at Fort George, and another at Tête Jaune Cache, but the members of these tribes could extend no reliable details concerning the country, for they never ventured therein for more than a short distance in quest of game.

To meet this condition of affairs special arrangements had to be completed. Fleets of canoes were pressed into service, every available one being acquired, and the Siwash Indians at Fort George were enlisted as crews, as these Red Men, though lazy to an extreme degree, are expert oarsmen and are acquainted fairly well with the river's numerous pitfalls. It was a rich harvest for them, for they demanded a daily wage of $3—12s. 6d. Fort George became the base of operations, inasmuch as the cost of freighting supplies westwards from Edmonton to Tête Jaune Cache, a distance of about 400 miles, at 20 cents—10d.—per pound was prohibitive. By shipping the necessities in from the south to Fort George, although an overland journey of 330 miles was incurred, the freightage charges were about 50 per cent less.

For 220 miles this route comprises a magnificent high road—so far as British Columbia highways go—having been built in order to facilitate access to and from the Cariboo Gold Fields, by which means Quesnel, a Hudson's Bay Post, and now a small town, was gained. This road was available for any ordinary class of vehicle, and to-day carries an automobile service. Thence the journey was over a more or less defined trail for 110 miles, to cover

which occupied at least five days by pack-horse. Since the railway was located the length of the Cariboo Road journey has been reduced to 163 miles by the inauguration of a steamboat service upon the Upper Fraser, plying between Fort George and Soda Creek, 155 miles of what was formerly the most arduous part of the journey now being covered expeditiously and in comfort by water.

Before the survey was undertaken camps were established at various points along the river between Tête Jaune Cache and Fort George, while the fleets of canoes carried up large supplies of provisions which were cached at convenient points. The survey camps were located always in attractive positions, and during our descent of the Fraser we found these abandoned camping-grounds an undisguised boon inasmuch as they spared us infinite labour and time in the preparation of a suitable site whereon to spend the night. The canoes plied to and fro incessantly during the summer, bringing in food and other requirements for the isolated parties engaged in locating the line, since their carrying capacity is severely limited—1000 pounds constitutes a heavy load for a single ungainly craft of this description.

Owing to the vicious character of the river this task was one beset with innumerable difficulties. Forty miles outside of Fort George is a furious rush of water over 9 miles in length—the Giscombe Rapids—where the water bubbles, froths, and speeds along at a terrific pace over a shallow bed littered with chisel-pointed rocks. Some 60 miles beyond is the Grand Canyon of the Upper Fraser, which is a veritable death-trap, where the inexpert, as well as the dexterous water-dog, often has met his end. Even the Indians for the most part regard it with a certain awe, especially during certain periods of the year, when it is little better than a maelstrom, and wherein several members of their tribe have met their Waterloo. The third danger is the Goat Rapids, a little west of the Goat River,

where the river tumbles downhill very suddenly, and where, in order to negotiate the boiling water, skilful navigation is imperative to manœuvre the boat from one side to the other of the river in order to avoid terrible obstacles.

Going up-stream these bad stretches could only be negotiated by dint of hard effort with the aid of a line or towing-rope, the crew, with the exception of one, hauling on to this frail device for all they were worth while the occupant of the craft picked his way carefully by the aid of his pole among the rocks. When the canoe was laden to the water's edge with cargo this proceeding was extremely hazardous, inasmuch as the danger from swamping was always existent and could not be circumvented except by extreme skill on the part of the man in the boat. Accidents were numerous, and fatalities were recorded time after time, but such were quite unavoidable in an enterprise of this character.

Many of these adventures teemed with excitement and tragedy. On one occasion a laden canoe was being lined up through the Giscombe Rapids. It was a heavy craft, and the Indians were hauling might and main, but making slow headway. Suddenly there was a sharp cry from the man in the boat. The curling water had swept the pole out of his hand, and the canoe, deprived of its guiding influence, was swung round by the rushing water, and hurled with terrific force against a rock. The boat split in two from end to end, as if cleft with an axe, the rope broke, and cargo, wreck of canoe, and Indian were thrown into the water. The Indian was never seen again. In another instance a party were coming up through the same rapids, and all were poling vigorously as the craft was otherwise untrammelled. But the water was running more swiftly than the canoemen, including members of a survey party, had estimated, and for their error of judgment they paid dearly. The canoe was tossed against a half-submerged rock, and, in the manner of the dug-out which is fashioned from the

brittle cotton-wood, it succumbed to the impact. In a few moments the occupants were engaged in a desperate struggle for their lives in the foaming water. One man was caught by the under-tow and never reappeared, two others failed to gain the shore and were drowned, while three were rescued.

Upsets were of frequent occurrence, for the Indian canoe, such as is built by the Siwashes of Fort George, is the most treacherous and tender vehicle for water service that was ever devised. The hull being round, the absence of a keel, and the non-provision of gunwales—the last is unknown to the Siwash—the boat rolls at the slightest movement on the part of those within, and a capsize is precipitated from a very slight cause. Hundreds of pounds of provisions were ruined or lost through swamping. One party of engineers were accustomed to canoe between the camp and the field of their day's labours, for at that point the survey skirted the river, and such locomotion was easier than tramping over the heavy muskeg. This practice was continued until one day the party, evidently having become so familiar with the dangers of canoeing in a dug-out as to treat precaution with contempt, had a rude awakening, for the boat was jerked out of their hands and then rolled over. Fortunately the accident happened near the bank, though the velocity of the current plunged one and all into a terrible struggle, with the result that the shore was gained only by dint of great effort, while the survivors were scattered along the bank over a mile or so, sorry but wiser specimens of humanity, some almost on the verge of collapse from their frantic battle with the river. Ever after that the river was left alone severely ; the surveyors trudged to and from their work, only braving the dug-out when compulsion rendered such a step unavoidable.

Probably the most dramatic accident was that in which another small party was wrecked in the Giscombe Rapids. The accident happened so suddenly that all were engaged

in a fierce fight for life before they realised that the remnants of the canoe had slipped from under their feet. One grabbed his dunnage bag and struck out boldly for the shore. But the current was too swift for him, and as his strokes became weaker the water dragged him down, until at last he disappeared from sight with a final despairing shriek. A companion who was a powerful swimmer kept himself afloat by great effort, but after he had been carried down-stream for over a mile he sank with startling suddenness, his body being recovered some time later at Soda Creek, having been carried some 200 miles down the river. One member of the party who could not swim a stroke clutched a piece of the canoe as it split up, and clinging desperately thereto, floated five miles down the stream. Then he lost grip of his frail life-preserver and sank. A fourth man who could swim, and who likewise seized a piece of floating jetsam, to which he clung tightly, in order to be carried beyond the confines of the rapids, ultimately gained the bank in safety.

From the constructional point of view the 190 miles through this valley technically offer but little difficulty; grading will proceed uninterruptedly at very high speed. Indeed the engineers consider that the hardest part of their work is completed when the line has gained Tête Jaune Cache. The existence of the waterway has facilitated the supply problem. Steamboats are to be built at Soda Creek, the boilers and machinery being hauled 163 miles overland from Ashcroft, the nearest railway point, and at Soda Creek will be installed in the hulls, which are to be erected on the water-side at this point. The cost of hauling the bulky machinery along the Cariboo Road, however, will assume a respectable figure. Tentative inquiries in this direction resulted in a demand of £8 per ton, the normal freightage rate being £12 per American ton. The main bulk of the supplies, however, will be dispatched westwards from Edmonton over the completed line to Tête Jaune Cache,

and there transferred to the steamers. Camps will be established at intervals of about two miles, and these will be in communication with the base at Tête Jaune Cache, so that armies of men will be poured into the valley continuously. By attacking the grade at eighty or ninety different points simultaneously, the permanent way will grow with striking rapidity. Where the line breaks away from the river for a considerable distance roads will have to be driven for short distances, but such preliminary work will not be extensive.

A couple of years from the day this section is attacked should see Fort George in direct rail communication with Edmonton, Winnipeg, and the east. The pioneers who have made their way laboriously to this centre, which is destined to become the most prominent junction of the Grand Trunk Pacific Railway in British Columbia, owing to the spur that is to be driven westwards into Vancouver, and which will blossom into the metropolis of the inland empire, will hail the arrival of the steel with unfeigned delight. In their anxiety to be first in the field these pioneers have suffered an existence of pronounced isolation with the nearest railway station 330 miles away, and have experienced every hardship incidental to frontier life. Provisions and other necessities have soared to fancy prices, for every ounce has had to be freighted in at a cost of between $50 and $60—£10 to £12—per ton from Ashcroft. The instant Fort George is in railway touch with the factories of the east, the transportation rate will drop to less than £2 per ton, and the town will go forward with an irresistible rush.

CHAPTER XVI

THE PERILS OF SEARCHING FOR THE EASY GRADE

ALTHOUGH the line, as now located, follows the broad route of the Fraser River, the task of the survey engineers through this territory was of a gigantic character, inasmuch as every possible mountain pass had to be surveyed, and had any of these been preferred to the Yellowhead, totally different country west of the Rockies would have had to be traversed. The toil amid the hoary caps of this mountain range was a magnificent achievement, as has been narrated already, but it is doubtful whether that confronting the plotters working in the vast expanse of New British Columbia was not of a more desperate nature. The only information concerning this territory and its general topographical features was that which had filtered through from a few participants in the Klondyke gold rush. Some hardy pioneers, lured north by the strike of yellow metal, essayed to gain the new Eldorado overland from the south. These indomitable spirits forced their way up the Cariboo Road to the Fraser, crossed this river at Giscombe Portage at the head of the rapids of that name, and then followed the famous cross-country trail of nine miles, to negotiate the divide on the opposite side of which is Summit Lake, the headwaters of the mighty Peace River, whereby the Arctic Ocean can be gained by water.

During our thrilling journey down the Fraser River in crazy dug-outs, we pitched camp one night at the mouth of the Little Smoky River, which flows into the former river from the north. Scarcely had we raised our tents and sat

to the preparation of our evening meal when we heard a cheery hail. It was the Romany of the wild waterways, the Fire Warden, Frank Stephens, paddling down the tributary, which he had ascended that day for several miles on his patrol duty, and was now returning home—if his nightly camping-ground could be called home—on the opposite bank. Cheered by the sight of a fellow-creature, for it is not his lot to see many faces beyond those of his wife and child, who travel with him, and the one or two settlers and prospectors scattered along the silent waterway, he paid us a visit, to learn something of what had transpired in the outside world up to the two months before, when we had stepped beyond the bounds of civilisation.

When we had exhausted our stock of news, which was limited to a severe degree, we requested a return of the compliment. But his world at that time was such a small one, the change from the humdrum of the silent wilderness was so slight and scanty, the empty forests afforded him such slender topics of conversation and scraps of intelligence, that he failed quickly. True, he could expatiate at length upon the possibilities of the valley, which he traversed from end to end along its criss-cross of waterways, but such could be summed up briefly in the phrase that " its potentialities in all directions of industry and commerce defied exaggeration." Then we mentioned the railway and that fired his conversational efforts. He had been attached to the surveyor who was deputed to carry out the flying survey between the western flanks of the Rockies and a line driven roughly through Tacla and Stuart Lakes to Quesnel —a task which had occupied the greater part of three years, involving complete immersion in the wilderness for the major part of that time, entailing strenuous fights against the unknown, privations inconceivable, and perils innumerable.

As we sat around the blazing logs that summer evening he treated us to two solid hours of thrilling romance in

connection with the plotting of this railway such as has been paralleled but seldom in the North American continent, and which afforded us a graphic idea of the formidable task the forbidding country offered the surveyor. We realised how heavily and continually the man in charge of the reconnaissance, working in a territory aggregating several thousand square miles, scarred by very few trails indeed, and where evidences of humanity were so few and far between as to appear non-existent, was "thrown up against it," as the breaking down of difficulty is described picturesquely in western frontier vernacular.

Frank Stephens was associated with the flying survey, because, being a man of the woods, hardened, like steel, to privation and exposure, he was an ideal associate for the man with the transit and level. Invariably they tramped about alone, and for the most part trod absolutely virgin country. It was a hard life, but, to a man of Stephens's calibre and experience, possessed that atmosphere of adventure and excitement in which the true frontiersman revels, while his resource and ingenuity, when they were trapped in a tight corner, stood him in magnificent stead.

As he remarked himself while he related his adventures, "no one was more surprised than I was that we came out alive, or, at any rate, without bearing more evidences of the hard knocks that we received in the prison of trees.

"At times we barely made five miles a day. Trails were denied us, for no Indian had ever ventured there. When we had penetrated the heart of the forest progress was so slight that we scarcely observed it. The dead-fall was maddening; it quite drove the windfall I had encountered previously into the trivial. The trees had dropped in all directions in this great primeval forest, for year after year, and, judging from the character and extent of the windfall, I should imagine that four times as many trees lay piled and rotting on the ground as were towering around us. To make matters worse, we could not hack our way through

the tangled wooden barrier, for the trunks were far too great in diameter—huge Douglas firs piled up to a height of 12 and 16 feet.

"Climbing was extremely dangerous. It was not as if you could scramble up one side of the obstruction and descend on the other, for when you got to the uppermost log the trees were scattered and criss-crossed in all directions below. One had to crawl gingerly along a monarch lying prone, with branches twisted in all directions, keeping a sharp look-out for snags, and securing as best one could a firm foothold upon the precarious slippery surface barely a few inches in width, since a fall would have been attended by a broken limb. As it was, we were torn, scratched, and bruised in all directions.

"Though such conditions were aggravating during the summer, they became a thousand times more so during the winter, for then the lurking death-traps were invisible—the snow concealed everything. On one occasion the surveyor and I set out together with four dogs, which carried the whole of our supplies, reduced to the barest necessaries. We purposely travelled lightly equipped, because we were bound for a trying stretch of country. Time after time that sledge was sent flying through collision with an unseen snag, and we had to keep close to the dogs, ready to lend them a helping hand the moment they got into difficulty, for the loss of an animal would have been a serious matter to us. We were travelling on snow-shoes, with our blankets and other personal requirements strapped to our backs, yet slowly and with great effort, for the ground was littered with windfall in all directions. We spoke but little, for when on the trail under such conditions all attention has to be focussed upon one object—the path immediately ahead.

"Suddenly I turned round to speak to my colleague, and, to my consternation, he was nowhere to be seen. He had vanished as completely as if the ground had swallowed him up. I called out his name, and there came back a muffled

SIDE HILL EXCAVATION ALONG THE SKEENA RIVER

Owing to the steep character of the river bank heavy earthwork was requisite to provide a path for the line. The soil as removed was shot into the water.

THE FOREST AS THE RAILWAY BUILDER FOUND IT

Owing to the denseness of the forest, and the size of the trees, clearing was a tremendous task. In this illustration the axemen are shown stripping the land of timber on the site of the railway line, yards, and port of Prince Rupert.

reply, as if proceeding from a cave beneath my feet. I looked round, and, following his footprints, came to a deep hole in the snow. Peering down, I saw the luckless surveyor. We were travelling over snow that had drifted and piled up over the windfall, and he had trodden upon a place where the crust was thin, and which had collapsed under his feet. It was a serious fall, too, for the hole was about 16 feet deep. I inquired anxiously if he were hurt, and gave a sigh of relief when I learned he had not been more than bruised and shaken in his unexpected tumble. But he could not get out. His snow-shoes and pack hampered movements, while the snags bristling on the fallen tree trunks rendered his extrication perilous. However, he released his pack and his snow-shoes, which I hauled up, and then moving very warily, he climbed out of the hole. He looked pretty scared when he reappeared, I can tell you.

"That surveyor, I think, was one of the most unlucky men who ever essayed to map the path for a railway. On another occasion, while surveying south of Fort George, he had a very narrow escape. The Fraser was frozen hard, and as it offered the best highway, he followed it. He was going through the canyon when suddenly there was a fierce yell, and he was seen to slip through the ice. We thought it was all up with him, but with remarkable presence of mind, as he sank he shot his arms out horizontally on either side over the ice, so as to gain a support and to keep his head and shoulders above water. He was pulled out half frozen, for being midwinter, the water was terribly cold. It seems that he had been going along on the surface of the snow, and had stumbled on a wide crack in the ice, which, being covered with a semi-frozen slush—the most treacherous covering on frozen water—it had simply given way under his weight. He had not seen the danger, because the slush was covered with a thin film of perfect snow, which gave no indication whatever of the danger below. Had he not thrown out his arms he would assuredly have gone under,

and his surveying career would have been brought to an abrupt conclusion."

This surveyor made no less than three journeys into the wild, inhospitable country north of the Fraser, in the search for the grade, his starting-point being Giscombe Portage, which was the natural place from which to commence such operations, as it marks the "height of land" between the Fraser River and the Peace River watersheds. During one summer he pushed his way eastwards from this point unaccompanied. His object was to find the best route between the Wapiti, Pine River, and Peace River Passes and Fort George respectively, since, as it was uncertain which way the line would come through the Rockies, a practicable highway via each respective pass was requisite. On one of these expeditions he failed to make good time while moving through the country, with the result that he was overtaken by snow while far up on the Salmon River, which flows from the north into the Fraser. It was a terrible predicament, for the surveyor's equipment was for summer travelling only, which, when the snow settles on the scene, is worse than useless. To aggravate matters his food supplies gave out on his homeward struggle. For three weeks he subsisted on nothing but ground-hogs, a kind of guinea-pig, which he caught as best he could. When at last he came in he looked an emaciated human wreck worn out by privation.

Stephens had his narrow escapes also during this exacting work, though in his true backwoods manner he made light of them, since he had issued scatheless from the dangers. Still he admitted that his adventure in the Giscombe Rapids was a "holy terror," and made his hair stand on end for some time afterwards. It happened in this way. He was making his way up-stream, was being towed in the usual manner, steadying himself, and guiding his craft meanwhile by the aid of the pole. The canoe had all but gained the top when there was a sudden vicious lurch, and

his crazy craft shot backwards from under him, to the accompaniment of an ominous singing. It threw him off his feet, but luckily he tumbled into the boat, and when he regained his senses, he found himself swinging along merrily, stern first, through the rapids, the canoe bouncing like a cork, and swinging from one side to the other, grazing wicked rocks as it was caught up by contrary currents in its mad career.

To attempt to arrest the boat would have been madness, and certainly would have ended in complete disaster, so he sat still, clinging tightly to the sides of his craft, as it rocked violently, expecting each succeeding moment to be his last. For three miles the boat danced precariously, and rushed along, dodging grim obstacles, as if steered by a mysterious force, then the waters easing up a trifle, he dug his pole sharply into the river-bed, regained control of the canoe, and punted leisurely into the bank, pretty well scared out of his wits, as he himself declared. What had happened ? Why, the rope towing the canoe had been sawn asunder upon the sharp edge of a rock, and the canoe had been thrown contemptuously into the rapids, to be the sport of the waters.

Desperate though his situation was in the rapids, Stephens regarded two episodes that occurred on the survey as the most exciting and narrowest escapes in his career. The survey party was at work on the Salmon River on the preliminary line. It was midwinter, and the thermometer hovered about 40 degrees below zero.

" One day a message came that we were to strike camp and to return to Fort George immediately. The journey was distinctly uninviting, for the weather was terrible, the country being swept time after time by blizzards, and under such conditions a trek of 100 miles was no light undertaking. Still, there was the official command, and there was no alternative but to obey. Our outlook was rendered blacker from the fact that we had very little food,

and, in fact, we debated whether there was a sufficiency to carry us over the 100 miles. Still, by eking it out and living on strictly short rations, we considered that we could just contrive to make the journey on what we possessed, while there was the remote possibility of some success falling to our rifles.

" The party set to work striking camp and loading the sleighs. Special care was observed in packing the precious instruments, so that they might not be injured in any probable mishap. Owing to the condition of the snow, the extreme litter of windfall, and the load, we had to become beasts of burden ourselves in hauling some of the sleighs, because there were not sufficient dogs for the purpose. Thus we set off. But the going proved worse than our most gloomy forebodings had pictured. The snow was soft, the dead-fall was strewn promiscuously and thickly in all directions, and more than once we stumbled into a pitfall, which enforced considerable delay. It was a racking, difficult journey. The men, weakened by insufficient food, toiled along mechanically, as if in a dream, blinded by snow, torn by the cold, and more than one afflicted with frost-bite. The rations sank lower and lower, and as we were yet a considerable distance from our destination, we had visions of making the last stretch on empty stomachs.

" At last the surveyor-in-charge called a halt. In order to ease the situation of some of the party, who were giving signs of the fatiguing strain, he ordered the sleighs to be lightened of all articles that could be spared. The more hardened of us regarded this proceeding with gloomy feelings, as an expedition sinks to low straits when it becomes necessary to abandon some of the impedimenta. Still, the weaker ones hailed it with relief as the loads they were called upon to haul were lightened appreciably. True, we were drawing nearer and nearer to Fort George, but our pace was so slow that the distance appeared not 100, but 1000 miles. Every day reduced our sup-

plies of food very visibly, and the plight of some of the party began to occasion the chief considerable anxiety. Articles were abandoned more extensively with every succeeding day, and finally even the sleighs were discarded. The trail for the last 10 or 15 miles out of Fort George presented a sorry sight. It recalled the overland trek to the Klondyke in the days of the gold rush, when the trail north of Edmonton was littered with abandoned necessaries of all descriptions. Still, we clung to the transit and level, and it was a half-famished, tottering little party that drew into Fort George, the majority more dead than alive from want of food and fatigue, though they soon revived when in camp once more with a variety of nourishing food in plenty.

" But I think the worse experience was when I was out with the surveyor-in-chief on the reconnaissance in the depths of winter. We had four dogs and a couple of sleighs not heavily laden. We carried our own sleeping-bags on our backs. Somehow or other, owing to the blinding snow, we were delayed and lost our way. But it was no use bemoaning our ill-luck. That does not help you one iota in the unfathomable wilderness of snow. The dogs had to go without food, and we ourselves did not taste a bite for two and a half days. Nor did we catch sight of the smallest specimen of game either. We were both becoming faint and dead-beat, with that awful desire to sleep, caused by the extreme cold, crawling over us, against which we fought desperately. We struggled along, hoping against hope, stumbling over concealed dead-fall, and knocking and bruising ourselves against obstacles which, had we been in the pink of condition, we should have seen and avoided. We stumbled rather than walked on our snow-shoes. One thing after another was thrown off the sleighs, to ease the plight of the dogs, which had grown so thin from want of food that their ribs projected through their skins.

" It was the third morning we had struck the trail with-

out breakfast. As we rolled out of our sleeping-bags the surveyor, faint from want of sleep, which hunger had effectually driven away, listlessly adjusted his snow-shoes.

"'Say, nothing but hot water for breakfast again this morning, Frank,' he remarked, with a forced laugh.

"'Guess not! But we shall not lose time by having to discuss one,' I rejoined. So we set off once more on the dreary day's round. Shortly afterwards we came to the conclusion that we could travel more quickly if the sleighs were emptied, so there and then we threw away everything except our bedding. This proceeding spurred us on a bit. Presently I descried in the snow the faint footprints of a jack-rabbit. It was the first sign of game and a possibility of something to eat which we had seen for three days, and I decided to stalk that rabbit, come what may. I drew my companion's attention to the footprints.

"'Now you stop here and light a fire. We'll have something to eat this morning, or I won't come back again,' I cried excitedly as I grabbed my gun.

"I sped off with my eyes glued to those scarcely discernible footprints, never losing sight of the spoor for an instant, in case my eyes played me false. But it was weary tracking; that trail was as elusive a will-o'-the-wisp as one could find in the forest. For three solid hours I followed it relentlessly, stumbling and falling wildly, bruising my shins and tearing my hands in my mad scramble to maintain my feet as I plunged through the bush. At last it disappeared into a willow shrub. Crawling up warily, I searched the thicket, and there spied the quarry I had been pursuing so diligently. Fearful that in my excitement I might take too hurried an aim with my rifle, miss, frighten, and lose the animal, I crawled steadily forward on my hands and knees. When within arm's reach I made a sudden spring and caught it by the scruff of the neck. In a trice it was dead and lifeless. But it was a sorry prize. Like ourselves, it was in sore need of food, for

it could obtain but slender sustenance from the snow-covered ground. Still, it was something with which to alleviate the pangs of hunger.

"I retraced my footsteps as hurriedly as I could, and in due time the yelping of dogs told me my toil was well-nigh over. As I burst on to the spot I observed the surveyor sitting before the fire holding his head in his hands between his knees, and rocking himself to and fro. He was the most abject picture of misery and despair that I have ever seen. When I showed him the result of my hunt he brightened up, but his face immediately dropped.

"'What's the good of it? We haven't any cooking utensils!' he muttered lugubriously. We had discarded them that very morning.

"'Well, I guess I'd sooner have the food and no utensils, than plenty of cooking vessels and no food,' I replied, as I skinned the precious rabbit. In a few minutes it was spitting merrily on an improvised roasting-jack. The skin I cut into four equal quarters, and distributed among the four dogs. They devoured it ravenously. Not an atom of that rabbit was wasted. While the chief regaled himself with the generally accepted edible portion of the animal, I cleaned the entrails and roasted them for myself. We did not know how long we should have to go before we made such a feast as this again. What was not eaten was carefully packed away on the resumption of our journey. That little bit of food put new life into us, and although the surveyor pressed me to share his portion, I declined. I was more accustomed to the woods and its hard knocks than he was."

Such affords a graphic idea of the pains and penalties that were incurred by the decision to thread this silent, unpopulated country by the iron road; to break its solitude once and for all; to wrest it from inaccessibility and primevalism, so that it might blossom as the rose.

CHAPTER XVII

OPENING UP THE LAST WILDERNESS

AT Fort George the railway parts company with the Fraser River. The waterway describes a sharp right-angled curve to flow almost due south on its way to the coast to swell the waters of the Pacific at Vancouver. On the other hand, the objective of the railway is Prince Rupert to the north-west, and which lies 550 miles north of Vancouver.

Ultimately Fort George will mark a "parting of the ways," from the railway's point of view, since commercial exigencies are demanding that the interior of British Columbia shall be rendered readily and easily accessible from the ports on Puget Sound. On the southerly run to Vancouver the railway surveys have indicated the feasibility of a line with grades and curves comparing favourably with those upon the other sections of this great trans-Canadian steel highway. This is an advantage which it is difficult to realise from mere mention, seeing that Vancouver is well served with railways connecting more or less directly with the Atlantic sea-board, but it was forced upon me very impressively while I was within the boundaries of the embryonic capital of New British Columbia.

Our camp was pitched beside the Fraser River under the shadow of the century-old Hudson's Bay Post, and at eventide we were visited by one of the Grand Trunk Pacific surveyors. His arrival had thrown the little colony of three hundred people into a frenzy of excitement: his

appearance with a full party of assistants all equipped ready for the front constituted the sole topic of conversation. What was his object ? Where was he going ? Was a new line to the south under contemplation ? Speculation was exceedingly busy. Every member of that isolated community cherished his own idea as to the reason of this surveyor springing suddenly into their midst. Three hundred people planned three hundred different railway lines out of Fort George. From conversation with the inhabitants a stranger would have gained the impression that the country was to be criss-crossed in all directions by an elaborate network of railways.

They spared no effort to satisfy their curiosity. When they met him in the streets he was bombarded with questions, and his camp, although some three miles out of the town, was not safe from invasion. But he was as silent as the Sphinx. He could not, or rather would not, gratify their thirst for information. He was not aware, so he said, that he was to start off on another survey expedition. He simply had been told by the engineer-in-chief in Winnipeg to proceed to Fort George, and to hold himself in readiness pending instructions. One morning the townsfolk awoke to find the little camp had disappeared—whither they did not know definitely.

One can scarcely realise in such a country as this how greedily a small settlement struggling along in the heart of the wilderness, 330 miles from the nearest railway station, seizes any straw that is likely to redound to the benefit and the improvement of their lot. Any tit-bit of information concerning railways is grasped feverishly, and in the course of discussion and conversation becomes magnified to an unrecognisable degree. One townsman related to me how he had seen such and such a survey party some miles west of the town busily at work. They were out for the Canadian Pacific. Another resident related a similar story, only he had noticed the party in

another quarter of the country, and they were working for the Hill interests. A third citizen had a similar story to relate, but in his case the surveyors were engaged at an entirely different point of the compass from the other two, and they were in the employ of a third railway group, and so on. One imagined that all the railways of North America were racing northwards to Fort George and the wonderful country stretching to the north. As a matter of fact, each individual had seen the selfsame survey party, but on different days and in different localities, for the revising surveyor runs through the country speedily. Still, the intense interest served to illustrate how significant a part the iron road plays in a new country on the dawn of development.

A few months later the surveyor I met at Fort George emerged from the wilderness at Vancouver; the original location has been revised and improved, and there is no use in disguising the fact that the Grand Trunk Pacific is going to provide another startling sensation—it is going to give Vancouver a faster and easier route to the wheat-lands of the prairie and the great industrial centres of the east. Whereas other railways have to struggle laboriously with grades varying from 116 to 237 feet per mile, the new line is going to have nothing heavier than 52 feet per mile. Traffic to and from Vancouver hitherto has followed certain channels because no alternative easier path was available, but the day is dawning when, in response to the demand for the annihilation of time and distance, a bold bid for supremacy is to be made.

Fort George will become the railway clearing centre of the interior; that is, if the Indians can be persuaded to assist in the march of civilisation and progress. But the red men have a grudge against the white men. When the first railway was built across Canada the natives were forced unceremoniously to leave the land along its route. As a *quid pro quo* they were given permission to roam and

settle just where they desired in the interior. The Indians tacitly accepted the inevitable, and the Government of twenty-five years ago considered they had completed a remarkable *coup d'état*, for the land farther north was of no value. At least, such was their opinion. But latter-day events have shown that the Indians secured the best of the bargain. They were permitted to become rooted upon the finest stretches of land in the whole of the province. The interior is nothing but one huge garden, where an equable climate prevails and where Nature has bestowed everything for the practice of agriculture upon the most successful scale with lavish profusion.

Little wonder, therefore, that the Indians did not contest their usurpation very spiritedly. They knew the north country from their trapping and hunting expeditions. They have acquired all the choicest area of land, from the arable standpoint, and when this country opens up in grim earnest the authorities will be faced with a pretty problem. The short-sighted policy of a quarter of a century ago is bearing its fruits now: the enterprising spirits holding the reins of government to-day, and having the general welfare of the whole country at heart, are engaged in the unravelling of the skeins which their forbears of the nineteenth century tangled in their sublime ignorance.

A striking example of this state of affairs has been offered at Fort George. The railway required a site for its imposing junction. There was only one spot available —a flat tableland approximating 1000 acres, in the angle formed by the confluence of the Nechaco and Fraser Rivers. It is about 20 feet above the level of the river and perfectly level—in short, it formed an ideal situation. But the Indians were in occupation, and they defied removal. The authorities coaxed and cajoled with the chiefs for more than two years, offering tempting sums of money and the allocation of other land as compensation. But

in negotiations of this character the cunning of the red man is inscrutable, and masterly skill and tact is demanded to prevent him obtaining a bargain too overwhelmingly in his favour. Two or three times the subject was on the verge of settlement to mutual satisfaction, when, just as everything was ready for the attestation of the documents, an obscure issue was thrust to the front and brought matters to a standstill. At the time of my visit the canny chiefs were taking a firm stand. The monetary compensation was equitable, and the offer of removal of the whole village, lock, stock, and barrel, to another location was fair, so they said. What, then, was the obstacle ? Oh ! there was a cemetery in the reservation, and the Indians vehemently opposed the disturbance of their dead. Anyone who has seen a Siwash cemetery will appreciate the joke of this objection. The graves had never occupied a moment's thought hitherto, as its weed-overgrown, tumbled, and neglected condition testified. But it was a powerful lever with which to gain time and to prise the authorities, possible of adjustment, no doubt, by an increase in the financial consideration, unless in the interim other issues became manifested.

The same difficulty has prevailed throughout the length of New Caledonia traversed by the Grand Trunk Pacific. A score of years ago the Indians thought but very little of their property. Now that the railway is approaching within measurable distance the land has soared to a value equal to that in the heart of a good-sized town.

Yet it is doubtful whether the greater majority of these natives have any conception of what a railway is. The older members of the tribe have heard so much about the invasion of their territory by the iron horse—its advent has been heralded so many times during their lives—that they regarded the subject with stoical indifference. When I discussed the project with the Siwash chief at Stony Creek he gave a broad grin. " Me heard tha' story when

me youn'—when me lik' tha' "—pointing to a little toddler of three years—" bu' me no see railway yet. Me nev'r shall."

The line strikes due west from Fort George, following the winding course of the Nechaco River. The permanent way for the most part is located on the bench-land that fringes this waterway, which in days long distant evidently occupied the whole of the depression through which it meanders. The land for the most part is covered with scrub which can be cleared easily, and which, when this is accomplished, reveals soil of marvellous fertility. The subsoil is clay or gravel, but it is covered with a layer of silt and decomposed vegetation varying from 4 to 28 feet in depth. Level country, however, is encountered but seldom, and then only in small areas. It is broken up by low hills which assume a north-to-south direction. In fact, it might be described best as the Weald of Kent reproduced upon a gigantic scale, for the general configuration is very similar, while the conditions are analogous.

The soil, from the character of its composition, is suited to the practice of every branch of agriculture. The vales are ideal for the raising of vegetable produce, the flatter areas to the production of grain, while the higher ridges are adapted to hay, which in its wild condition grows with striking luxuriance, and averages from $1\frac{1}{2}$ to 2 tons per acre. The wealth in this direction is considerable, as is proved by a glance at the rough-and-ready stacks on the Indians' reservations and the homesteads of the few settlers who have forced their way into the country.

The true future of this great territory lies in diversified farming. The man who selects New British Columbia as his home in preference to the prairie will reap an envious reward in a few years. Unlike his colleague on the wheat-land, he will not place all his eggs in one basket—if one crop fails the abundance of another will make ample amends. On the prairie there is no such compensation.

If the grain should happen to fail, then disaster would stare the homesteader in the face; there would be no escape. But when the farmer is raising a little of everything from fruit to stock, vegetables to poultry, a complete failure is scarcely possible. This is the reason why to-day British Columbia is making such a strong appeal to the true farming instinct.

Moreover, the natural conditions indicate that diversified farming should be practised. The whole of this territory will be self-supporting. When the country has become settled by the completion of the railway there will be no need to send a single ounce of produce east of the Rockies, or west of the Cascades. Again, though this agricultural belt is of tremendous area, it will never be able to meet the entire local demands. In the mountainous area fringing the Skeena River is a vast mineral storehouse. Commercial minerals of all descriptions are being found in abundance. Consequently mining towns, settlements, and villages will spring up on every side. These will demand food-stuffs, and naturally they will draw upon the sources of supply which are immediately available, for the produce will be fresher, in better condition, and cheaper than that which has to be brought over a long railway haul. This is the reason why the land throughout the Nechaco, Endako, and Bulkley Valleys, as well as that around the François, Ootsa, and Stuart Lakes, is being bought up so feverishly.

The advance of the line, the stories of striking wealth, and the resources of the country traversed have fired speculators to a frenzied degree. Ten years ago you could buy the choicest of this land at about 50 cents—2s.—per acre; to-day you cannot buy it for less than from $30 to $60, or £6 to £12, per acre. The railway has precipitated a land boom which is one of the most notable in the annals of Canadian history. Where a decade ago you would toil along for day after day without seeing a human face

beyond that of an Indian, and would not catch a glimpse of development on the land outside the reservations, to-day there are evidences of great activity in land improvement on every side. As we wended our way over 320 miles of trail forest fires raging on every hand indicated settlement, for the new arrivals were burning off the scrub, while stakes, indicating the acquisition of stretches of land, appeared with the regularity and monotony of milestones. The country is undergoing a marvellous transformation, and with a remarkable rapidity in the bargain.

Leaving the Nechaco River at Fort Fraser, the line skirts the southern bank of Fraser Lake and the Hudson's Bay Post to enter the Endako Valley, which is a continuation of the fertile conditions prevailing in the Nechaco Valley. In due course it traverses the bench-land lining the eastern shores of Burns and Decker Lakes. Then it has to commence its first serious though easy climb upon the 230 miles between Fort George and Aldermere, because a low ridge, the Bulkley Summit, strikes at right angles across the location. The ascent, however, is so gradual that the official requirements regarding grade are fulfilled without any effort.

Indeed, the country rises very gradually from Fort George northwards to this ridge. At the former point the grade is at an elevation of 1880 feet. It makes an easy ascent through the Nechaco Valley to Fort Fraser, which is at an altitude of 2230 feet, the rise in the first 100 miles only aggregating 350 feet. From the Hudson's Bay outpost, looking northwards, the Bulkley Summit ridge is plainly visible about 100 miles distant, and at the point where the line enters the Bulkley Valley, at the confluence of the Morice and Bulkley Rivers, the altitude is 2366 feet. Then there is a descent for some 60 miles to Aldermere. Thus it will be seen that the country throughout the 230 miles is of a give-and-take character, the line undulating in the form of a gentle switchback.

The Indians evinced extreme interest in the survey of the line through their territory. Some who were employed for menial duties with the parties related vividly dramatic experiences with the men equipped with the transit and level upon return to their villages. The instruments and operations of the chain-men and rod-men puzzled them greatly, and many were the jokes they bandied between themselves concerning the methodical movements of these members of the party. But the phase which afforded them infinite delight and provoked extreme amusement was the assiduity with which the surveyors sought to make their way round the hills. This was absolutely beyond their comprehension. When I was at Stony Creek, although the location had been completed some two years or so before, they had not ceased joking about the surveyors' industry in this direction. While I was conversing with one of the Siwashes who had been associated with a survey party he gave vent to repeated grim chuckles. Unable to realise the source of his amusement, I finally inquired why his risible faculties were so provoked. He gave a broad grin, and then spluttered: "Whi'e man, he dam silly fool! 'E no go ov'r 'ill lik' Indian, dat quick'r; but 'e go roun', dat muc' slow'r!"

When Aldermere is gained the mountainous country is entered. The outer flanks of the Cascades loom up, and the massive humps crowd so closely together that there is scarcely space for the iron road. The Babine range thrusts its slopes so sharply forwards to meet the coast range that emergence from the valley to Hazelton is through a narrow defile extending for about 14 miles, until the Skeena is gained. The bottom of this gorge is occupied by the Bulkley River, and the water tumbles along in a series of rapids and falls. The banks run up sharply from the water's edge, and at places are sheer, giving the rift, through which the river makes its way, the appearance of an immense crack in the earth's surface. The rocky sides

of the canyons are cut so cleanly as to present the appearance of having been cut by cyclopean chisels.

Under these conditions the engineers found it a difficult matter to plan an easy grade. Here and there the line is poised from 100 to 200 feet above the foaming river hurrying to join the Skeena. At intervals there is nothing but a narrow ledge, which has been cleared of trees and debris to allow the waggon road and railway to run side by side. The vehicular highway, however, has but indifferent respect for grades, and falls continually as Hazelton is approached. The railway, on the other hand, holding to its gradient, rises higher and higher up the mountain-side, and the side hill work in this district is as heavy, if not heavier, than that encountered in the wildest parts of the Rockies. So tightly do the opposing ranges press together finally that no possible surface outlet from the valley was found feasible for the railway. As a result, it became necessary to drive a tunnel through a massive shoulder. The original survey showed 4000 feet of subterranean work, but indefatigable revision has enabled the length of the tunnel to be reduced to about 2000 feet. In its revised form, however, the tunnel ranks as the longest on the whole of the 3543 miles stretching from ocean to ocean. Bearing in mind the magnitude of the undertaking, this is a surprising result, but when the enterprise was projected the surveyors were urged to reduce tunnelling operations to the minimum, for these works are not only proverbially expensive and demand considerable time to accomplish, but are far from being popular with travellers.

According to original intentions the line, when it reached Aldermere, instead of bearing sharply to the north and gaining the Skeena River at Hazelton, was located almost due west, emerging from the Cascade range at the mouth of the Copper River, 100 miles distant from Prince Rupert. A natural pathway was offered, as the route followed first the course of the Tel-kwa River, and then clung to the

Copper River to its confluence with the Skeena. But as the line follows the north bank of the Skeena River in order to enter Prince Rupert, a massive steel bridge would have been necessary to carry the track across this waterway from the mouth of the Copper River. This location held out the distinct advantage of reducing the mileage between Aldermere and Prince Rupert from 246 to 166 miles—a saving of 80 miles—which was no slight consideration from the capital expenditure and capitalisation points of view, bearing in mind the heavy cost of building a railway in such forbidding country.

However, the Government authorities demanded that the Skeena River should be gained at Hazelton, the headwaters of navigation on that waterway, and an important Hudson's Bay Post. By so doing the valuable mineral and agricultural country lying around Hazelton, especially to the north and east thereof, would be rendered more accessible, both from the coast and from the south. In time the strategical and traffic advantage of this move will become more apparent than it is to-day. North of Hazelton extends a highly fertile, wide depression—the Kispiox Valley, in which over 100,000 acres of excellent arable land are available—stretching into the Yukon territory. The Grand Trunk Pacific Railway has received the charter for the construction of a branch line to Dawson City, there linking up with the Alaskan railway system now in course of completion, and the obvious route of this spur lies through the above valley, with a point near Hazelton constituting the natural junction with the main line.

It must be borne in mind also that the Grand Trunk Pacific undoubtedly will construct a second line to the coast running in a north-westerly direction from Edson, threading the Peace River Pass and the wonderful arable belt of 10,000,000 acres that is opening up so rapidly along that waterway. In that event connection with the existing line will be effected near Hazelton. At the same time,

RAILWAY CONSTRUCTION ALONG THE SKEENA RIVER

The banks of this waterway are serrated by deep wide bays. In order that the line should be free from curves the engineer struck across these indentations, throwing up a substantial ridge of rock and gravel.

however, exigencies, no doubt, will demand the adoption of the cut-off via the Copper River, for 80 miles represent no mean saving in through coast-to-coast traffic. Such a line will become essential if the coal-field which has been discovered among the mountains in this region, and which is in close proximity to the original location, proves worthy of development. Should this fulfil anticipations—these coal deposits are estimated to exceed in extent the bituminous coal area of the United States—it would play an important part in the future development of the northern stretches of British Columbia, more particularly owing to the extensive areas of other minerals that there abound.

The present location, north of Aldermere, traverses a continuous mineral belt where extensive discoveries of copper, silver, lead, gold, and so forth have been made. Many are merely prospects at present owing to the difficulty of introducing the requisite machinery, but the completion of the line will enable the commercial value to be determined within a short time. Certain it is, however, that three camps within easy reach of the railway will become permanent mining settlements—the Silver Cup, Twelve Mile Camp, and Four Mile Camp respectively—while west of Hazelton is Nine Mile Mountain, which is a mass of mineral.

There is no shadow of doubt but that for the whole 600 miles between Tête Jaune Cache and Hazelton the railway traverses a country the possibilities of which are quite beyond realisation. However, the surprising activity among the pioneering settlers in the agricultural areas augurs well for the success of that ramification of human endeavour, as my personal investigations established conclusively, while the army of prospectors in the immediately contiguous mineral country, the variety and extent of their prizes of ore, and their buoyant optimism presages a rosy future for the mining industry.

CHAPTER XVIII

LIFE IN THE RAILWAY CAMPS

IF one wishes to see the rough life in the wilderness at its best one must visit, live, and move in a railway camp. It is a strange, albeit fascinating, little colony. There is an atmosphere of devil-may-care on every hand, such as is met with in no other phase of human existence. The grader is a personality of himself, a desperately hard worker, who revels in the open air, enjoys toiling far beyond the limits of civilisation, and who makes money plentifully. The days when such centres of activity were hot-beds of lawlessness, crime, and gambling have vanished for ever so far as Canada is concerned. A modern railway camp in the heart of the wilds has a social level and a moral code superior to what may be found in many thriving towns, as I found from experience. The work is exacting, for the task of laying the thin thread of steel is beset with dangers innumerable. That, however, is the element which above all exercises such a bewitching glamour.

One looks in vain for the gin-palace, gambling-saloon, and other sinks of iniquity; searches in vain for the human vultures who thirty years ago used to prey upon the unsophisticated wielders of the pick and shovel, for the professional grader, though a rough diamond, is as simple in the ways of the world as a child, and certainly has no idea of the value of money. Legislation has stamped out such plague-spots as relentlessly as hygiene and medicine have mitigated the ravages of disease in the camps. The men, instead of being the outcasts of society, dragged down to the lowest depths, and seeking sanctuary in the wilds, where no questions are asked, and where there is no

probing into private affairs or the past, have developed into thriving, industrious settlers. The Golden Calf may be worshipped, but that is a failing which cannot be overcome, for it permeates the whole community of the twentieth century—it is the one obsession of to-day.

Yet the railway camp has lost none of its peculiarly picturesque characteristics. The men are just as rough, brusque, and abrupt as ever. There is nothing of the velvet glove, for the contest with Nature is too grim and stern. They have a rough idea of hospitality, but it is sincere. If one happens to visit the camp, he is not permitted to continue his journey without inquiries being made as to his well-being. Has he had a meal? If not, he must partake of one straight away. They follow a happy-go-lucky existence. They carry their lives in their hands, incur extreme risks in their haste to fashion the grade, bite their lips determinedly when confronted with eternity, and laugh mockingly when they glide safely by the looming portal. It is a life of "luck"; a daily juggle with Fate.

Nor has the camp lost its cosmopolitan character. If anything, it is more so to-day than it ever was. Every type of nationality will be met with along the grade. A little colony may represent as many as ten, fifteen, or twenty different tongues, from Russian to Hindoo, from British to Slav, from Scandinavian to Turk. Yet there is no misunderstanding, no hesitation or confusion. Each man has his allotted task to perform, and he goes his way oblivious of all external influences.

Now and again there is a hitch, conflicting interests clash, and sometimes resort is made to force to settle the dispute. Then the rest of the colony gather around to enforce fair play, for no underhand tricks are permitted. The time was when heated words in a railway camp soon provoked a revolver-shot, but nothing more formidable than fists are allowed to-day, and the canons of fair play are administered with austere severity. Occasionally I saw

tempers aroused quickly, and words lead to blows, but no more harm than a severe pommelling with fists was inflicted. The combatant who stooped to mean advantage would have received terrible punishment from his assembled comrades.

But it must not be imagined that a camp is a scene of such disorder. Far from it. Peace generally prevails, but when seventy, one hundred, or possibly two hundred men are thrown together, for month after month, to live like a huge family, it would be a strange coterie indeed if disputes did not arise occasionally.

A camp offers golden opportunities for the psychologist. The general opinion of the navvy as he is seen at home is totally different from his counterpart as I saw him along the Grand Trunk Pacific Railway right-of-way. Every calling had its representative. There was one finely built, brilliant, enterprising, well-cultured young fellow I met at the entrance to the Rockies. He would have looked more appropriate in immaculate white starch and a sombre morning suit at work in a stockbroker's office, than he appeared in muddy, torn, and patched khaki trousers, a brown flannel shirt open from the neck to the waist, and top-boots trundling a wheelbarrow through the muskeg. Piqued by curiosity, I asked why he had penetrated to such incongruous surroundings. His reply was frank, curt, and to the point—" To make money ! I should have starved as a clerk in London. Here I am earning a steady four shillings a day clear, delighting in braving the extremities of heat and cold, defying Fate, and having a general good time in the purest open air."

It must be admitted that, from whatever point of view the lot of the grader is surveyed, it is far and away superior to that prevailing among workmen at home. They live healthier, brighter, and happier lives, while the wages are regular and steady. East of the Rockies unskilled labour receives on the average $2—8s. 4d.—per day. If a man is

skilled in some branch of railway engineering his wages are proportionately higher, according to his ability. For instance, a timekeeper receives $75—£15—per month inclusive. In other words, this sum represented the amount he could save every month, the only essential deductions being expenses for such trivial luxuries as tobacco and articles of clothing which he might require. From the daily wage the navvy had to deduct 75 cents, or 3s., for meals, and $1, or 4s., per month as his subscription to the medical department, which secured him highly skilled attention and care in the hospital, and ample quantities of medicine from the dispensary, if incapacitated by accident or illness. Therefore a man could rely upon saving about $25, or £5, per month, since he was deprived of all opportunities to waste his wages, unless he gambled among his colleagues.

The ease with which money has been earned and saved, however, has exercised a retarding effect to a certain extent. A man arriving at the camp with empty pockets has found himself possessed of a small nest-egg at the end of six months. Perhaps he has never had such a sum in his possession before in his life. Instead of staying on the grade, he has improved his position with this capital by acquiring a homestead—the railway has set him firmly on the road to become a prosperous farmer. So far as the camps east of the Rockies were concerned, the effect of this constant coming and going was not reflected upon the progress of the work to a pronounced degree, as strangers anxious to secure a start in their new life in a new country poured into the camps every day to take the places of those who retired from the grade. But on the Skeena River section it exercised a decidedly adverse influence. It was not so easy and simple a matter for labourers to gain the Pacific Coast, while very few of them possessed the wherewithal for the steam passage over the 550 miles northwards from Vancouver. Then, when they did reach the grade, the

approach of spring offered so many openings to earn higher wages in various other channels that they left the line. During the year 1910 the shortage of labour assumed serious proportions. The development of Alaska, the extreme activity in mining circles around Hazelton, the Babine Mountains, and Aldermere, where the men could command from $4 to $5, or 16s. 8d. to 21s., per day, lured them from the railway camps. The contractors raised the wages to $3, or 12s. 6d., per day, and even at that figure could not attract sufficient unskilled labour.

The head of the contracting firm responsible for the completion of 240 miles along this river expressed his preparation to take on 5000 men, if they presented themselves at Prince Rupert. He made desperate efforts to attract men to the spot. Labour was recruited in these islands, and passages were paid to the camps. Upon arrival the men settled down to work, but in the course of a few weeks they drifted to all parts of the Dominion, attracted by more enticing openings for the sweat of their brow. On one occasion a whole boat-load of men were shipped north from Seattle to Prince Rupert. Not one of that consignment of labourers ever reached the grade. As they disembarked from the vessel at Prince Rupert other ramifications of industry, pushed just as hard for labour, absorbed every man at a higher wage than he would have received on the railway. It was only during the winter, when other opportunities were closed by snow and ice, that a sufficiency of men could be secured to carry the work forward with an appreciable speed, for then it was the only employment available.

So far as the social conditions are concerned the grader has no cause for complaint among the Grand Trunk Pacific camps. Here the lot of the workmen has been lifted to a far higher level than has ever prevailed before in connection with railway constructional operations on the North American Continent. The substantial character of the log

shacks has been described already. In winter they are wonderfully cosy and warm. In the bunk-house the sleeping quarters are ranged in two tiers on either side of a longitudinal passage, the berths being disposed like those on board a steamship, with spruce boughs for mattresses. One sub-contractor went even further to render his men comfortable. Single iron beds with mattresses were installed, and a man was deputed to look after the graders, whose sole duty was to keep the couches in trim condition, and to provide the men with hot water for a wash and brush up when the day's work was done. The mess shack is likewise a roomy building, replete with what comforts the bush will permit. The cook has a commodious kitchen with outhouse attached, while within convenient distance is the cache, in which the nine months' supply of provisions is stored.

The sanitary arrangements are such that the possibility of the drinking water becoming contaminated is reduced to the minimum. This precaution has been responsible for the strikingly clean bill of health that has prevailed among the 50,000 men scattered along the grade between Moncton and Prince Rupert. Epidemics, such as decimated railway camps in the early days, are now almost unknown, and, even should contagion appear through the carelessness or ignorance of the navvies—a danger that is ever present among the workmen hailing from the unsavoury quarters of Europe—the medical department within easy distance is able to cope with the malady and to stamp it out before it secures a firm foothold.

If there is one point more than another that tends to maintain harmony and satisfaction in a camp it is the skill and accomplishments of the cook. The contractors display unremitting care in this direction, for experience has taught them that to feed a man adequately and well is to offer more than complete compensation for the loneliness of his situation. An indifferent cook will precipitate

discontent sooner than anything else. By means of an attractive wage, ranging from $60 to $75—£12 to £15—per month, with all found—on the Skeena River the wages averaged $100, or £20, per month—first-class men skilled in the mysteries of the culinary art, so far as it affects these rough men, were secured. Many young fellows whom I encountered presiding over the camp-kitchen along the grade could offer a more varied, appetising, and better prepared assortment of nourishing dishes by means of the diminutive cooking-stove, stoked with wood and the barest of utensils, than the *chef* of a first-class hotel, surrounded by every device ingenuity could contrive to facilitate his task.

Yet the position of the cook is trying. The tastes of these graders are peculiar. But they have one gastronomic failing—that is "pie." A cook who can make delicate pastry and is a master at "pie," no matter of what description, whether it be mince, pineapple, raisin, apricot, or what not, will be forgiven his lack of skill in preparing other dishes. To the western grader "pie" is the dream of existence, and when the men find they have secured a jewel of a pastry-cook they spare no effort to keep him in an affable mood.

To my surprise I found that a large number of these backwoods *chefs* were young English fellows. At home their roving dispositions, which would not permit them to settle down to humdrum existences, had caused them to be classed as "ne'er-do-wells." But they were far from being ranked in this category in their new environment. They revelled in the life, for the wage and freedom made strong appeal to their natures. Having no appearances or social positions to maintain, they save money easily, while there is ample recreation and diversion in the pursuit of game when the day's duties are completed. One camp cook I met had amassed a huge collection of bear-skins, moose-heads, and other trophies of the forest which had fallen to his rifle, and he was consigning them home. From

conversation with his comrades I learned that their acquisition had developed into a perfect mania, and he had experienced adventures in the quest of fur which would have been the delight of a big-game hunter.

The daily round in the camp is somewhat monotonous, but this cannot be avoided, bearing in mind the prevailing conditions. The cook is astir at five o'clock in the morning, and is faced at once with the preparation of the matutinal meal. About six o'clock he tears the workmen rudely from their bunks by vigorously clanging a ponderous steel triangle. The men tumble out hurriedly, and the bank of the creek in a few minutes is the scene of great animation as the morning ablutions are being performed. There is no etiquette at the backwoods dining-table, so the men hurry one after the other into the mess shack, their faces aglow under the combined action of soap and towel friction. Each man helps himself, and there is no limitation. In a large camp silence at table is an unwritten law. This custom is requisite inasmuch as the cook is the sole waiter, and were boisterous conversation permitted he could not possibly hear and attend to the men when they requested this, that, or something else. Nor is there any waiting for sluggards. If a man desires an extra ten minutes in bed, he runs the risk of losing his breakfast, for the cook is the Autocrat of the Table, and, like time and tides, waits for no man. When he clangs his gong the meal is ready, and the first arrivals fare best.

The meal is such as few workmen at home ever discuss once in their lives. The variety is infinite and everything is in plenty. The first course comprises porridge, followed by grilled bacon, pork, and haricot beans, cold ham, tinned meats and other condiments, with hot bread and butter, jams, cakes, and other little dishes, with the irrepressible "pie" occupying a prominent position. Each man appears to possess a huge hotch-potch before him, for the rule is one man one plate, and that of enamel. The cook

has quite enough to do without being harassed by a huge pile of plates and platters to wash up after every meal. The meal is accompanied with coffee and tea, not raw, but flavoured with milk and sugar.

By seven o'clock the men have departed to the scenes of their labours. The cook snatches a little respite, partakes of his breakfast somewhat leisurely and in solitary state, for meal-time is a busy rush with him. But he cannot dally long, as the midday meal has to be prepared. The hooter of one of the engines blaring out twelve o'clock precipitates a spirited rush towards the mess shack. The men come in as hungry as hunters. Bowls of steaming soup disappear with astonishing rapidity, and then the main dish of the meal is attacked in decided earnest. Here, again, there is variety to meet different tastes. One can revel in juicy steaks of fresh meat, cold meat, bacon, corned beef, with potatoes baked and boiled, tinned peas, beans, Indian corn, or other vegetables. Even fresh fish is often available to those who prefer it. Then come the sweets, ranging from pies of all descriptions to milk puddings and stewed fruits. Or one can have cakes and jam, crackers and cheese with pickles, rendered more appetising by the aid of such condiments as tomato catsup. Salads are available occasionally. For liquid refreshment there is tea and coffee, or if something cold is preferred, then lime-juice can be obtained. The consumption of this cordial is astonishing, but it serves to protect the men from the ravages of scurvy, which is a serious menace, seeing that they are necessarily heavy meat-eaters. According to their own statements, a man could not toil so heavily and so continuously were he not able to secure large supplies of meat in various forms, and from experience I must admit candidly that to attempt such labour on a vegetarian diet is to court physical disablement. Meat appears to be the only article of food which can supply the requisite stamina for so many hours on end.

Seeing that the men are buried in the wilds so far away from the busy cities, they must be dependent to a very great extent upon tinned comestibles. Such can withstand the rigours of transport, while also they preserve their original excellence almost indefinitely, the loss from storage and inclement climatic conditions being reduced to an infinitesimal degree. The perfection of canning and preserving science has changed the life in a railway camp completely. It has enabled food-stuffs to be brought within reach of the humble navvy which formerly were quite impossible. Shredded dried canned potatoes are even obtainable to-day, and are used in place of the fresh article in the outermost camps. The contractors, however, always secure fresh foods if such are available, and this demand has been welcomed by the pioneer homesteaders who have had the courage to penetrate the wilds in anticipation of the railway.

While I was at Aldermere a Chinaman broke into a frenzy of delight at a stroke of good fortune. The purchasing agent of the railway had been searching the country for supplies of fresh potatoes. This indefatigable Oriental had been expecting such a move, and had raised seven tons of tubers accordingly. The purchasing agent was willing to acquire the whole consignment, and they haggled for over an hour about the price. The Chinaman wanted so much per ton, but the agent, armed with figures which indicated the price at which the potatoes could be brought into the country from Vancouver, was adamant. The upshot was that the wily Celestial parted with his produce at $100—£20—per ton, and over the transaction had made sufficient profit to enable him to buy his settlement of 160 acres outright.

Fresh meat is one article of diet for which the graders hunger. At first sight it might be considered as impracticable to gratify this desire, but the contractors rose to the occasion. If the country traversed could yield anything

in this connection it was purchased, but if not, then animals were shipped by rail to the end of steel, and from that point they were driven to the various camps and there slaughtered.

On the Skeena River section this problem assumed grave proportions. The cost of bringing the carcases by water from Vancouver to Prince Rupert, and thence distributing them along 240 miles of grade, was abnormally high. So they conceived another plan. A contract was made with a cattle-raiser in Southern British Columbia to drive large herds overland to a point about one mile below Hazelton. It was a daring undertaking, for it involved a " drive " of 420 to 700 miles through thick bush country. As an experiment 600 cattle were driven across the province, and the journey occupied about twenty-five days, the cattle grazing as they proceeded. Upon arrival at the destination they were turned loose, to be coralled for slaughter as required. A large modern abattoir was erected, and the carcases were then shipped down the river to various points where small cold-storage depots were established, and from which the camps were served.

The experiment was found so successful that a further contract was signed with the cattle man, whereby he undertook to deliver 5000 animals in the same manner during the summer of 1911. Owing to the beasts being driven across country at a leisurely pace, and being able to obtain fodder in the form of luxuriant vetches and grasses in abundance as they ambled along, or when they stopped for the midday meals and night camps, the meat was found to be of excellent quality, as the animals arrived in the primest condition.

The last meal of the day is discussed at six o'clock in the evening. It is similar in character and extent to the midday repast. Then the men while away the rest of the evening according to individual inclinations. Some indulge in fishing, for the streams, rivers, and creeks teem

with rainbow and bulldog trout, pike, and even salmon, which are to be caught readily, and thereby the menu is varied appreciably. Others cultivate small patches around the shacks if the soil is suitable, raising vegetables for the table, lettuce and onions being the most popular delicacies. Some extend the cook a helping hand by splitting sufficient cordwood for his fire during the following day. Games serve to pass an hour or two away, while reading among the more cultured members is a popular recreation, but, unfortunately, there is a dearth of reading material. The phonograph has proved an excellent diversion: there is scarcely a camp which does not possess at least one talking machine. In this manner the time flies rapidly until nine o'clock, when the greater majority of the men retire to their bunks.

Such is the round day after day for six days in the week. On Sunday there is a complete cessation of work, and the time is passed either in hunting, fishing, by visits to neighbouring camps, or in some profitable occupation. Some of the men devote the day to the performance of essential domestic duties, sufficient for the ensuing week, the trees around the shacks becoming involved in a network of lines carrying laundry of all descriptions. Occasionally a peripatetic "man in the frock" will appear on the scene, and though he seems strangely out of place in such an environment, yet he is certain to secure a fair hearing. Indeed, the majority of these missionaries who travel up and down the grade receive a warm welcome, for they have become accustomed to the graders and their peculiar ways. After a little informal Gospel chat, in which the speaker takes care to clothe his main idea in a manner acceptable to his auditors, the whole party invariably gather round and indulge in the exchange of reminiscences and adventures along the grade, for the grader is a born raconteur and has a wealthy store of anecdote.

The various institutions, such as the Young Men's

Christian Association, the Salvation Army, and the Navvies' Mission, have done yeoman service in improving the social conditions in the camps. Through their instrumentality magazines and books are circulated to gratify the desires of those who wish to read ; a vigorous educational campaign is maintained among the illiterate, while the foreign element is taught English. Though the main aim of their operations may be described as " Christianising," it is accomplished in such a diplomatic manner that the men do not resent the efforts of these organisations. If there is one thing more than another which the grader detests it is out-and-out preaching. To attempt such is to meet with gibe and joke, while words fall on deaf ears. These graders live in a world of their own, and they have no desire to venture beyond its confines. But if the mission of faith is prosecuted carefully it meets with considerable success. The men show their appreciation of this work and the self-denial of those engaged in the improvement of their interests in a practical manner, and woe betide a colleague if he forgets to contribute his mite.

How successful such missionary effort can be made was demonstrated conclusively along the Skeena River. Here the liquor at first was a potent disturbing element, for, given the opportunity, the average grader will waste every penny of his hard-earned substance in riotous living— " amusement," he calls it. Though Canada has a rigorous liquor law which prohibits the sale of any intoxicants within a certain area of a public work, such as railway construction, yet at places it is impossible to enforce this enactment without pressing harshly upon other members of the community. It was the case on the Skeena River. The line was located near Essington, which had come into existence years before, because it became the centre of the salmon-fishing industry. Being a law-abiding little town, licences had been granted before the Grand Trunk Pacific Railway was ever contemplated. To have withdrawn the

licences or enforced a period of abstemiousness to enable the railway to pass would have damaged legitimate traders, and would have been resented by the inhabitants.

The contractors were placed in a quandary. Directly the graders received the cheques for their month's wages they trooped off to Essington to have them cashed at the saloons. They not only cashed the paper there, but squandered the whole of its financial value in drink, and did not reappear on the grade for several days. To make matters worse, lawless members of the community, who always hang on the flanks of a railway constructional army, hurried up from the States. According to the prognostications of these parasitic worthies, the good old times were coming back in regard to railway camps at Essington, and snares of every possible description to lure the workmen into despicable dens to rob them of every cent they possessed sprang up on every side.

To combat these disturbing influences the Y.M.C.A. consummated a crowning achievement. Their forces were in charge of one of the oldest missionary campaigners in North America, who had fought the human vultures tooth and nail in the great railway camps of the United States. He was no idle preacher, but an aggressive militant. By means of various counter-attractions he induced the men to stay in the camps on Sundays, the day they generally selected for an excursion to Essington, and even waylaid the men as they received their wages, and offered to take care of their money or to cash their cheques if such was desired. Only the more hardened and reckless spirits declined his proffered help, but they were in such a minority that the sycophants of Essington became disgusted with the fruits of their ill-famed traffic, and left the district breathing threats of vengeance upon the Y.M.C.A. The leader of the latter became so popular, for he could keep the graders fascinated with his exciting adventures on the grade, that his meetings were always crowded. His

breeziness and humour fascinated the men, and even the habitual lovers of a carouse in time abandoned their visits to the saloon town.

When the railway had advanced beyond Essington some of the liquor-spiders, driven to desperation, resorted to subterfuge to trick the men of their money. As the graders would not come to the town to spend their wages in alcohol they would take the drink to the camps. But in so doing they came within reach of the stern arm of the law. Still, they considered the risk well worth incurring. They carried bottles of poisonous whisky, and peddled it out in insidious small quantities at fictitious prices. But the foremen of the gangs soon observed that their men were suffering from the effects of alcohol, and directly the ruse was detected the whisky peddlers received very short shrift. They were stripped of their bottles, which were smashed, and in some cases even the graders themselves took the law into their own hands and gave the illicit vendor a sound drubbing, with the intimation that if he were caught in the neighbourhood again he would run the risk of being thrown into the Skeena River. The vigilance of the foremen and others became so acute that whisky-peddling became too dangerous an occupation, the vendors shrank from the risk of being caught, and in a short time the traffic died out.

The Prohibition Law is one of the wisest and most beneficial Acts of legislation that the Canadian Government ever has brought into force. It has purged the camps virtually of vice and crime. Although some 50,000 men were scattered along the grade, and despite the fact that the men were drawn from every corner of the globe, and even included the scum of the earth, lawlessness was practically unknown. Liquor was recognised as the most disintegrating and inflammable factor among these camps, and so it has been stamped out rigorously. Not a dram of intoxicant is permitted to enter a camp, and no new

town is extended a liquor licence, so long as it is within a certain distance of any railway constructional work. This fact has become noised far and wide, and consequently many of the graders when proceeding to a camp have a final indulgence on the way. If they arrive at the camp under the influence of liquor, as a rule they are placed under restraint and thereby deprived of the chance to create disorder. True, it must be admitted that a large number of the men lead a sober, steady life from "lack of opportunity," but that was the main reason which impelled the passing of the Act.

But prohibition legislation has given birth to a new calling—the smuggling of liquor and the fabrication of vile intoxicating concoctions from doubtful materials by individuals who are ever ready to trade upon and profit by the weaknesses of their fellow-men. So far as Western Canada is concerned, the North-West Mounted Police is able to cope with this evil. A couple of these Riders of the Plains will keep 400 miles of the grade clear of liquor, for they represent the law in an autocratic manner. They know the class of men who indulge in this nefarious traffic, and directly they hear that the clandestine distiller and smuggler is busy in a certain district they will spare no effort in scouring the neighbourhood and treating him according to his deserts. Seeing that these officials may have to ride hard for 100 miles or more to investigate a suspected instance of liquor traffic, they leave no stone unturned to discover the culprit and his iniquitous machinery, which is smashed to pieces, while the offender is fined heavily on the spot. Should he prove an old offender, then he is escorted to prison, and if other than a Canadian he runs the risk of ultimate exile. The Mounted Police is the Nemesis of the illicit liquor-vendor, and the intimation that one of their number is approaching is sufficient, generally speaking, to cause the evil-doer to hie to pastures new with the utmost speed he can command.

CHAPTER XIX

THE "STATION-MAN"

ORDINARY labour, however, has its limitations. The workman toils for ten or eleven hours per day, week in and week out, for month after month at the same daily wage. He can estimate just how much he will be worth in six months' time, for the scale never fluctuates in the slightest, unless the elements supervene and compel periodical cessation. When this occurs the grader loses the sterling value of that period of enforced inactivity, just the same as a labourer in any other field of industry where payment is made upon the time scale. The adversity of the elements is one factor against which the contractor is powerless, though it must be pointed out that the weather must become intolerably unpropitious to bring railway-building to a standstill. Its influences are experienced most acutely in the rock cuts, where the powder and fuses are apt to become damp, and the safety of the men is liable to become seriously jeopardised by miss-fires, or through shots hanging fire.

Yet the labourer need not remain a mere navvy. It rests with him if he shall be a mere cog in the complex machine that drives the grade forward, earning a clear dollar per day. He can improve his position, and possibly lay the foundations of a successful career, if he feels disposed to display a little initiative and determination, and is not awed by the prospect of having to work hard and continuously through all the days of daylight. In short, he can become a station-man: can blossom out as his

own master upon a limited scale. In such a case the proportions of his monetary reward are governed entirely by the extent of his own industry and capacity.

The station-man is a peculiar feature of American railway-building operations, and has proved so successful as to become regarded as an institution. Some might describe him as a sub-contractor, but he is not, though, if successful, he develops thereinto within a short time. He requires but a few pounds capital with which to commence operations, and he need not be apprehensive concerning the wherewithal for the purchase of plant and material. The chief contractor is prepared to equip him with every requirement essential to the completion of his task, even to food. When the work is finished the contractor merely deducts his advances in kind and material from the sum due to the station-man, and the balance which the latter receives represents clear net profit.

As already mentioned, the locating engineer indicates the route of the line by means of wooden stakes planted uniformly 100 feet apart. Each of these divisions, or units, represents a "station"; in other words, it outlines a certain amount of excavation or filling that has to be carried out, the extent of which is shown in the survey and which varies obviously according to the country traversed. The station-man undertakes to take over 100 feet, or perhaps two, three, or more such units, to complete the grade thereon in conformity with the specifications, and to hand it over to the contractor ready for ballasting. The latter, when he receives it, has nothing further to do.

The station-man works upon a yardage basis—that is to say, he receives a certain sum per cubic yard of earth removed. Now, the contractor builds the line upon the same basis, so he secures his profit in the difference between what he receives and what he pays the station-man. The price paid to the latter varies according to the classification of the material in which he is working. East of the Rocky

Mountains the price was about 22 to 24 cents—11d. to 1s.—per cubic yard for "common," such as gravel, clay, and so forth, which could be handled easily by the simplest tools, and 35 cents, or 1s. 5½d., for loose rock. In regard to solid rock this presented a totally different aspect, as this excavation had to be carried out by highly skilled men, together with more or less extensive plant, so that the scale of payment therefore was high.

It is "common" and loose rock classifications of excavation that the average station-man undertakes to handle, because his expenditure thereon for plant or the hire of same is reduced to the minimum, while a station can be completed comparatively quickly. For the first-named a barrow, shovels, picks, crowbars, and one or two planks suffice, and these can be rented very cheaply, while if bought outright they do not constitute a very heavy outlay. Of course, the material as excavated may have to be hauled some distance, in which event a narrow-gauge tramway, cars, and horses will be required. But the average station-man arriving on the scene with only a little money in his pocket will concentrate his initial energies upon the easiest units so as to secure a foothold. If that proves profitable then he launches out, assuming heavier and heavier responsibilities as he progresses in a measure commensurate with his success. Possibly on the first undertaking two or three men will co-operate on a station, sharing the profits equally between them.

There is one distinct advantage about this system. There is a direct incentive to work hard and long. Profitable success is dependent entirely upon the celerity with which the unit of grade can be completed, and this in turn means the more work that can be crowded into a day the higher the reward. It is no uncommon circumstance for a man to be able to earn as much as $10, or £2, per day at station work, and as his expenses are very small the week's effort shows a high return.

SURVEYORS MOVING CAMP AMONG THE MOUNTAINS

The rivers and lakes constitute the easiest highways for travel in the unknown west, where roads do not exist and horses are unavailable. Huge rafts are formed of dead trees lashed or pinned together with wooden pegs, which the men load with their clothes, provisions, and other goods.

"STATION MEN" AT WORK

The line is pegged out in units of 100 feet, each of which is called a "station." The workmen, either co-operatively or individually, undertake to complete a section upon a kind of piecework system. They live a dog's life, work from fourteen to eighteen hours a day, but earn from £8 to £12 per week.

This system appeals to the foreign workmen, especially to the Galicians and Hungarians. These men, accustomed to small wages and the poorest of living for long hours of hard work in their own country, can make large profits out of a station, which to the average British labourer would show the slenderest margin, if any at all. They are particularly at home on the "common," no matter how uninviting the task may be, such as, for instance, excavating to a depth of 10 or 12 feet through slimy muskeg.

When they first assume the responsibility of building 100 feet of grade they live a pitiable existence. They subsist on the plainest and cheapest of food, invariably pork and beans, thereby cutting down their living expenses to the irreducible minimum compatible with keeping body and soul together. Yet as workers they cannot be equalled. Their knowledge of English is confined to but a few words, so if they work on a time scale their hours of enforced leisure are a misery, as they can neither converse nor understand their colleagues. Under such conditions time hangs heavily on their hands, and they would be far happier at work in the cut or on the fill with the shovel and wheelbarrow.

I passed an interval with one of these station-men. He was a new arrival with capital comprising one month's wages at day labour, and he cut his expenses to a very low level. His home was a small wooden shack barely eight feet square, and was noisome to an extreme degree. His entire wardrobe consisted of a pair of tattered nether garments and a discoloured, mud-stained flannel vest, while his feet, from which socks were absent, were encased in a pair of heavy boots. He was up with the sun in the morning, and four o'clock saw him slaving away as if for dear life. It was a monotonous round; his shovel swung regularly to and fro until the wheelbarrow was loaded, then there was a short run up a narrow plank, a dexterous tilt, and the vehicle was discharged; then he ran quickly

back with it to the site of excavation, and the cycle of operations was repeated. He made no pause for meals, but hurriedly swallowed some of the pork and beans, an ample supply of which he carried in a tin pail. They were devoured while cold, because they would have taken more precious time to eat had they been hot! He kept himself glued to his task until the shades of evening had fallen and the gathering mantle of night prevented him from seeing more than a yard before him. He was making between £10 and £12 a week clear at this slavery, and yet he was as happy in his own little world as if he were revelling in the lap of luxury.

Sunday, which had to be regarded as a day of rest, was spent in performing what little washing met his limited needs, and the preparation of a supply of food almost sufficient for the whole of the following week. Upon the completion of these duties he indulged in a good sound sleep to make amends for the brief rest he had taken during the six previous nights. No visitor disturbed him on his station, unless a stranger like myself appeared. The only other face he saw was the resident engineer or one of his staff who visited the station every day to inspect the work and to check the extent of the excavation.

It is not surprising that these men make money quickly, and that in the course of a few months they are able to undertake either larger undertakings or to shake the dust of the grade from their feet and to settle down upon a homestead. The great majority of these Slav station-men work industriously on the grade for six months, and devote the remaining months of the year to the fulfilment of the legal requirements on the free farms. In this way they earn sufficient on the railway to keep them on the farm for an equal period of time, and then are able to show a respectable sum on the right side of the year's balance-sheet. At the end of three years they hold undisputed

title over 160 acres of arable land, can point to a good stock of implements, a small balance at the bank, and some cattle—all made out of the grade. The most remarkable feature about these men is that although they deny themselves every luxury and comfort in their early struggling days, once they have become established on the ladder of success they fly to the opposite extreme and demand the best and most expensive of everything.

The loose rock is taken in hand generally by a superior class of station-men, but invariably men who have risen as it were from the ranks. This work for the most part is a trifle more expensive, as it demands a certain quantity of plant, especially in regard to haulage facilities. They can hire these, however, at a reasonable figure from the contractor. Also, they cannot accomplish the work single-handed, so must employ labour, and for the wages of the latter they must possess a certain capital. There is one salient characteristic with regard to this system. A man may embark upon a station, and for some reason or other meet with financial disaster. This is a common occurrence when working in rock. Becoming bankrupt, it may be considered that his labourers have but a slender chance of receiving their wages. But here the chief contractor comes in. He is always indebted to the station-man for a certain sum of money as payment for completed work, and from this balance the men working for a daily wage under the defaulting employer are paid.

Moreover, the men are not thrown out of employment. When a station-man fails the contractor steps in and keeps the gang going. Even should there be no balance due to the station-man, Mr. J. W. Stewart informed me that his firm made an invariable practice of meeting the wages bill of all defaulting station-men working under their banner. This is a wise policy, since when a large foreign element is engaged on the task the failure to receive wages when due at the end of the month might precipitate

strife very readily, owing to their generally excitable temperament and ignorance of bankruptcy laws.

It might be thought that such an arrangement lent itself to indifferent work, or over-payments in regard to station contracts. But the system of checking and counter-checking in vogue upon such undertakings is too intricate to permit such a contingency arising. The contractor checks the work performed by the station-men. The resident engineer also carries out a similar operation on behalf of the railway company. Two independent results of the same task are thus obtained. If a dispute arises, and this occurs very seldom indeed, unless some unforeseen circumstance has developed, it is a simple matter for representatives of the contractors and the railway company respectively to repair to the scene in which the dispute has arisen, there to investigate the matter on the spot, and to re-check the whole result by independent operations with the transit. If the resident engineer is a capable man discrepancies in the figures cannot arise very well, unless the work is intricate, but in no case yet has it been necessary to have recourse to an arbitrator on this undertaking.

Nor can the work be scamped. The resident engineer visits each station-man in turn nearly every day, while his superior officers make periodical visits of inspection. Lastly there is the resident Government engineer, representing the third party to the contract, as the Government payment is in proportion to the cost of the work, and consequently this representative takes extreme care to see that the term " cost of construction " is kept down to the lowest figure consistent with the specifications and first-class workmanship.

The best type of station-man is found upon the mountain section, especially along the Skeena River, where the grade has been driven for mile after mile through the solid rock. This phase of the task demands the highest skill, for the work is tedious, expensive, and laborious. Should the

station-man's gang be deficient in skill, labour may be wasted very easily ; more rock than is requisite may be removed, and as the limit of " over-burden," that is, the extra rock over and above that essentially necessary to excavation, is reduced to the minimum, the station-man takes care that true value is obtained for every inch of drilling and every ounce of powder used.

The capital expenditure on this work is heavy indeed. The drills, hauling plant, camp equipment, and such like may represent an expenditure varying from $3000 to $5000—£600 to £1000—just to complete 100 feet or so of grade. Consequently a fair amount of capital is necessary to commence operations. Yet if the task is carried out in a business-like manner, the net return may run into very high figures, so that the risk is well worth incurring.

But this work finds out an incapable station-man very quickly ; nothing will bring him more readily into the arms of bankruptcy than 100 feet of hard rock. When the Skeena River section was undertaken, the news of the profits that were being made by expert rock-blasters and drillers precipitated a station-man speculating fever. People in all walks of life thought that building the Grand Trunk Pacific Railway through the Cascade Mountains was a certain and short road to affluence. They thought they had nothing to do but to hire the plant, obtain men, buy powder, and set the gang to work, and that then they could sit quietly by and figure in the air how much they would be worth by the time the " station " was completed. Butchers, bakers, hairdressers, and what not invested their little capital and made merry in anticipation. But their joy was short-lived : they received a rude awakening. The first month caught several of these hair-brained speculators short ; found them on the wrong side of the profit-and-loss account. One after the other went under, caught in the financial debacle. Those who escaped the first month or two spared no effort to get out as quickly

as possible, disposing of their plant at ruinous scrap-heap prices, so as to save a little from the wreckage.

But this experience which taught a salutary lesson had its advantages. It enabled men possessed of little ready money, but plenty of brains and aptitude for the work, to secure a foothold, and some of these men have made small fortunes. Probably the first 100 miles of this section was responsible for the greatest number of speculative victims, owing to the prevalence of wet weather, for the rainfall in this area is tremendous, averaging about nine feet per annum. Day after day the rain pours down almost with tropical fury, and a rain-storm lasting several days without cessation is no uncommon feature. Under such conditions blasting work could not be carried forward, the drill-holes would become filled with water, the powder became caked and soddened and failed to explode. The men who did not realise their business failed to appreciate the significance of this factor, and consequently suffered the penalty of their temerity.

Rock-work on the Skeena has been carried out for the most part by Scandinavians, who are expert in the economical removal of rock, and American station-men, who from long experience among the mountain railway enterprises in the United States were expert in the manipulation of the drill and blasting charge. The Italian, who is a rock-worker to the manner born, as the boring of the great Alpine tunnels has proved overwhelmingly, has not appeared very prominently upon the Skeena River. The wet climate was in such contrast to the everlasting sunshine of his native country, and wrought such havoc with his health and constitution, that he avoided this region. As a matter of fact, this workman has not been very much in evidence upon the whole length of line, though he is found in strong force farther south. The Swede, whose homeland is a mass of rock, and who is taught to blast and excavate this tenacious material

almost from the day he can handle a tool, and to whom the climate is in no way strange, has accomplished tremendous work. Scandinavians are found scattered from end to end of the line where heavy rock cuts have been imperative. I passed through camp after camp of these industrious, fair-complexioned, and hardened fellows, which afforded little glimpses of the Land of the Midnight Sun. I visited several colonies the members of which could not speak more than a dozen words of English, and where the foreman had to act as interpreter. However, the men acquire the English tongue with marvellous rapidity, and after a few months' residence on the grade become expert linguists.

The station-man as a rule endeavours to secure the easiest and simplest portions of the line, leaving the contractor to handle those stretches offering the most perplexing difficulties. Yet on the whole the practice is highly advantageous to the contractor. It offers scope for ability, and places a premium on expedition in construction, inasmuch as it is to the station-man's own interest to complete his task with all possible speed. Personally the contractor is indifferent whether the man fulfils his station in four weeks or four months—it costs the same from his point of view. On the other hand, were the stretch to be undertaken by direct time labour procrastination would tell a different story. It is the station-man who suffers if he nurses his undertaking too long, though if he is too dilatory he runs the risk of the contractor terminating the arrangement and completing it himself, especially if the particular station is in urgent request, and is delaying the completion of so many miles of grade ahead.

The contractor also derives his margin of profit from various contributory sources. There is first the direct revenue representing the difference between the sum he receives and what he pays the station-man per cubic yard, the income derived from the hire of plant, and the profit accruing from the sale of requisite material such as

explosives, provisions, and other incidentals, for the main contractor acts in the capacity of universal provider to the grade.

The fostering of the system has also resulted in the fulfilment of a high class of work. On the Skeena River section there is a short two miles of line, which adjacent station-men informed me was the finest piece of track on the continent. It was carried out by a small party of Scotsmen who had acquired their knowledge of railway-building in the Highlands according to the British standard, which is admitted to be a stern school, demanding a high class of work. They emigrated to the West, and when they secured a consecutive number of stations they proceeded to turn their knowledge to account, and to build the line in accordance with the lines prevailing at home. What is more, they succeeded, and as they worked upon the co-operative system, they emerged from the task with a large balance in their favour, and with the proud distinction of building two miles of line as good in every particular for a new line as could be found at home, and which was something distinctly different from what was generally seen in America. As one Irish-American who had been a station-man for more years than he could remember remarked, "Those raw Scottish lads taught the rest of us how a grade ought to be built."

The station-man's part in the construction of the Grand Trunk Pacific Railway probably never will be appreciated. Yet it is due to his enterprise, unflagging energy, and indomitable pluck that the undertaking has made such rapid progress. Having everything to gain and little to lose, these spirits, with an unfathomable intrepidity, rushed in where contractors hesitated to tread. Some of the more audacious spirits on the Trans-Continental section startled the engineers by their daring. Instead of taking over stations near the main field of operations, whence supplies, material, and men could be transported easily, they took up sections far in the heart of the wilds. They enrolled

their crews or secured kindred spirits to co-operate, and plunged forwards boldly. The cost of freighting in was tremendous, for there was scarcely a waggon road over which to pass to and fro. But these reckless worthies were not daunted. They cut a rough highway without any waste of time, and by dint of frantic effort and tremendous endeavour were able to start work. What was more to the point, they completed their self-imposed tasks to their own financial satisfaction. How they netted their profits, considering the heavy preliminary expenses they incurred, passes human comprehension

One of the resident engineers on the Trans-Continental division related how more than once he had endeavoured to dissuade a station-man from embarking upon an apparently impossible proposition, but had been consigned promptly to a warm climate and told to mind his own business. The little colony was isolated; scarcely a word was heard of it. Yet in due course the station-man reappeared. His section was finished, and he flourished his balance-sheet and received his profit, anything up to $2000 or $3000—from £400 to £600—as a reward for the sweat of his brow and his audacity. The fact that the station-man and his colleagues must have toiled like Trojans once they got on to the ground, and thus had compensated for the heavy outlay necessary to commence operations, was only too apparent from the financial result. These dauntless individuals stop at nothing; they take long chances; their faith in luck is implicit. If they fail, well, they simply keep quiet for a short time until another favourable opportunity develops, when, in response to the urging of the mania with which they are smitten, they make another plunge. But the fact that a station-man can accomplish from four to six times as much work in a day as another labourer working on the daily wage scale, offers convincing testimony to the value of the practice.

CHAPTER XX

THROUGH THE CASCADE MOUNTAINS TO THE PACIFIC COAST

IN order to gain the Pacific sea-board from the interior plateau of New British Columbia, some heavy constructional work has been requisite. The highlands are fringed on the western side by the Cascades, which rise up in the form of a lofty, abrupt rim, to tumble just as steeply and brokenly into the ocean. As a result, the engineers and graders have accomplished a monumental achievement, which eclipses the section through the Rocky Mountains in point of daring and resultant effect. Indeed, the stretch of line between Prince Rupert and Kitselas Canyon, on the Skeena River, a matter of about 100 miles, and in which the heart of the mountain chain is traversed, is regarded as the most marvellous piece of railway engineering among the mountains in the whole of the North American Continent. Not that the topographical conditions were favourable to the engineers : far from it. On the other hand, the situation presented a far more appalling aspect from the technical point of view than the location through the Yellowhead Pass.

The Skeena River follows a sinuous course from the interior to the sea, the channel being a wildly picturesque gorge hemmed in on either side by lofty summits. The rocky slopes shelve up sharply from the water's edge in a continuous series of rolling shoulders and spurs to towering heights, which for the most part are wreathed eternally in snow and ice. Another adverse factor is the steepness of the river's grade. From Hazelton to Prince Rupert is 186 miles by water, and in the course of 120 miles the river drops about 1000 feet, rendering it one of the fastest running waterways on the coast.

Whereas the Rocky Mountains rapidly decrease in height as the range recedes northwards from the 40th parallel, the Cascades, on the other hand, become more tumbled, lofty, and massed as they approach the Arctic Circle. Moreover, they thrust their western slopes closer to the seashore, the coast-line having a forbidding, precipitous appearance. For instance, when travelling overland from San Francisco, Seattle, or Vancouver, a considerable mileage through gently rising country is traversed before the mountains proper are entered, though their frowning white caps are observable from the track for some time previously. Quite a different state of affairs exists 550 miles north of Vancouver, however. Prince Rupert, the Pacific terminal of the Grand Trunk Pacific Railway, is situate on the flanks of this range, and immediately the precincts of the station are left the toil through the mountain barrier commences. The solid rocky ridge towers above the waterway without a single breach for 60 miles. Then suddenly a huge rift is observed, and this gap has become known, with colloquial appropriateness, as "The Hole in the Wall."

The location of the line through the Cascades was carried out by Mr. C. C. Van Arsdoll. With Prince Rupert as the terminal the task of finding a route to the interior tableland was rendered extremely intricate. Indeed, there was only one available channel through the range which he could follow, and that was along the banks of the Skeena River. Though the original idea reduced the traverse of this waterway considerably, as at a point 100 miles from the terminus the waterway would have been crossed to gain the Copper River, yet it was this first 100 miles which offered the most abstruse problem. When the Government stipulated that the line should skirt Hazelton, necessitating the Skeena River being followed for a further 86 miles, the latter division did not increase the surveyor's task to any material degree, inasmuch as the mountains fall back after Kitselas Canyon is passed. From that point onwards there

is a tortuous valley extending to Hazelton, though low hills have to be overcome with startling frequency.

The perplexing question was the location of the railway over the first 100 miles. The problem was rendered additionally exacting owing to Prince Rupert being on the north bank of the river, the estuary of which, as with the Fraser more to the south, is a huge land-locked bay several miles across. Indeed, the river is tidal for about 60 miles, and at tide-water it opens out very suddenly to about one mile. Consequently, being confined to the north bank, the most feasible location there had to be discovered.

As the mountains fall abruptly into the water, and in many places sheer up almost perpendicularly, there was no natural ledge or other foothold at their bases of which advantage could be taken. When the water was sounded alongside the bank, the latter was found to continue the mountain profile, falling down just as steeply to a great depth, so an artificial embankment could not be built up from a submerged ledge. On the tidal section of the river the shore is heavily indented, some of the bays extending back for great distances. In other places the area between the mountain base and the main channel of the river is studded with low-lying islands—practically mud-flats covered with dense scrub—which at certain seasons of the year are submerged almost entirely. When the river is low the lower-lying stretches behind these flats form backwaters or sloughs, swampy in character, and littered with floating debris brought down by the raging waters when in flood.

Under these circumstances it was impossible to follow the contour of the shore without producing a line abounding in sharp curves and twists, whereas the official stipulations concerning curvature were most stringent. Nor could the engineer strike to a higher level up the mountain-sides in the hope of gaining a more favourable location, since the introduction of heavy gradients would have been necessary,

A Marvel of Railway Engineering

For one hundred miles through the Cascade Mountains the railway clings to the north bank of the Skeena River. For sixty miles through the heart of the range the line is absolutely level, an unparalleled feat on the American continent in connection with this mountain chain.

inasmuch as the line at Prince Rupert is barely 20 feet above high-water mark.

This was the outlook when the surveyor ventured into the field with his transit and level, and the reconnaissance only served to emphasise the stern proportions of his enterprise. Then the preliminary flying survey revealed another danger. The Cascades differ from the other mountain ranges on the American Continent in that they do not run to sharp, needle-like peaks. The crests assume rather the form of flat, massive humps, from which the flanks fall away sharply. The result is that in spring the avalanche, land- and rock-slides, constitute formidable and actively aggressive menaces. Evidences of these sensational visitations were revealed to me on every hand during my run down the river. At places the whole side of the mountain has slipped away bodily, leaving a bare, scarred vertical surface of rock as cleanly cut as if with a chisel, and over which mountain torrents thunder with terrific violence. The tracks of the avalanches also were discernible easily, and there was ample evidence that these perils ravaged the mountain-sides every spring with unfailing regularity. The tracks of such movements consequently had to be avoided widely, which was no easy matter, bearing in mind the confined area available to the surveyor.

Although the line makes as direct a route as is practicable between Prince Rupert and Hazelton, no inkling is afforded of the enormous amount of work the surveyors had to accomplish to secure the adopted location. To produce this 186 miles involved the running of over 12,000 miles of trial lines or surveys. In other words, approximately 65 miles of possible lines had to be carried out and investigated thoroughly, to obtain each mile of the location. This affords some idea of what surveying for a railway means in such a country as this, and why the plotting process occupied so long a period.

In regard to the surveyor's anxieties concerning the

Cascades an amusing story was related to me by G. Horne Russell, the well-known Canadian artist. He was commissioned to visit the Skeena River to secure canvas glimpses of its magnificent scenery and most prominent mountains. As little was known about the river-side and the points where the most impressive views of mountain grandeur could be obtained, it was suggested that he should enlist the assistance of Mr. Van Arsdoll, who from his work in the country could be relied upon as being thoroughly conversant with its topographical features. Upon arrival at Prince Rupert the artist approached the divisional engineer, made known his quest, and sought advice. The engineer listened attentively, and then replied quizzically : " Well, I'd willingly help you if I could, but, to tell you the truth, I don't know much about the mountain peaks. I've scarcely ever noticed them. My greatest worry has been to get round their bases ! "

Head-quarters for the survey were established at Prince Rupert, and camps were distributed at convenient points along the river so far as Hazelton. Communication between the various camps was maintained by means of small, shallow-draught, stern-wheel steamboats, burning wood as fuel, ample supplies of which fringe either side of the river. These vessels represented an outlay ranging between $40,000 and $50,000—£8000 to £10,000—each, are of the type generally found on frontier waterways, with the pilot-house set at a high level, and in general appearance somewhat resemble a house-boat. These craft, however, differ materially from the historic Mississippi boats, the behaviour of which provoked President Lincoln to remark that " they had to stop every time they blew the whistle," as there was not enough steam for operating both machinery and syren at the same moment, for they work at 180 pounds steam pressure, and can attain a speed of about 14 miles an hour. At times, however, this speed is inadequate to make progress against the current of the river, which in times of high

RAILWAY CONSTRUCTION STEAMER ON THE SKEENA RIVER

The Skeena River is a wild cataract tumbling through a break in the Cascades. It abounds with canyons, rapids, sandbars, and other formidable obstructions, rendering navigation exceedingly difficult. Its velocity is so great that it takes boats, although they can travel 12 miles an hour, from two to five days to cover 186 miles up-stream, whereas coming down the journey can be accomplished in 14 hours.

flood rushes along here and there at a speed of about 25 miles an hour.

The Skeena River is one of the most capricious, erratic, and treacherous waterways among those flowing into the Pacific Ocean along the North American coast. Apart from its fiendish velocity, which in itself is a serious peril to navigation, it fluctuates in level with astonishing rapidity, rising and falling as much as six inches or more in a single night. It drains an extensive mountain area north-east of Hazelton, and is fed by melting snow. It reaches its highest level in June, when the warmth of the summer sun melts the snow on the mountains rapidly, and then it is converted into a veritable mill-race from source to estuary, rendering navigation extremely precarious. At those points where the river attains its swiftest pace the steamer has to " line " up. A canoe pushes off with 1200 feet of wire-cable, and poles up-stream. One end of the cable is made fast round a thick tree, and then the little boat drops down-stream, paying out the cable in its descent until it gains the steamer, when the free end of the cable is thrown aboard and passed round the steam capstan in the bow. The capstan is set going, and the vessel hauls itself up-stream foot by foot, assisting in the operation with its own propellers. With the engines running at their utmost capacity, progress is so slow as to be almost imperceptible, so adverse is the speed of the current. When the river is thus in flood it occupies from five to eight days to cover the 186 miles between Prince Rupert and Hazelton —travel being confined to daylight—whereas the down-river journey can be accomplished in fourteen hours !

The passing of June sees the river rising and falling incessantly during the summer months, for in the higher mountains the snow which falls overnight is melted during the following day, this alternating movement continuing until autumn is advanced, when, the sun becoming powerless, the snow remains on the mountains, while the river

persistently drops until at last it is unsafe to navigation, owing to insufficient depth of water, for the bed is strewn with rocks, boulders, and sand-bars. The last-named are the obstacles most feared, for they are shifting continually under the force of the river's current, and will even disappear from one spot to reappear somewhere else in the course of a single day. The river is most powerful in its scouring action, and brings down immense quantities of detritus, which is deposited here and there promiscuously. It is the shifting character of these sandbanks that has contributed mostly to the river's ill-fame, for it defies being charted. The Yukon, Stickine, and Naas have achieved evil reputations, but those waterways, as the captains of the Skeena River boats admit, from their own personal experience, are safer and easier to navigate, for the obstacles retain their relative positions, except such as are formed of floating trees, whereas the Skeena does not run alike for two consecutive days.

The two most treacherous spots are Kitselas Canyon, about 100 miles distant from Prince Rupert, and a stretch of rapids known as the Hornet's Nest, near Hazelton. The former is probably the greatest danger. The upper portal, divided into three passages by sharp rocky ridges, has to carry the whole volume of the river, which just above resembles a large lake. The steamboat passage is barely 60 feet wide. The canyon is three-quarters of a mile in length, and the declivity is awful. When the river is in flood it is absolutely impassable, owing to the pace of the water, which thunders through at about 30 miles an hour, while at low water it cannot be traversed because of the rocks, which are barely below the surface. There is a gauge at the lower entrance, for the guidance of navigators coming up-stream. If they cannot venture through the canyon, they unload their cargo at the lower point, and it is transferred across country by a cable-way, where it is re-embarked upon another vessel, if one be available. To give

some idea of the fierce character of this short stretch of the river, and how the waters are crowded to make their way through the narrow fissure formed by the rift through the rocky walls on either side, when the gauge records a rise or fall of 12 inches at the lower portal, the fluctuation in level at the upper entrance is no less than 4½ feet!

It is very seldom that vessels can traverse this canyon without recourse to "lining-up," and shackles have been driven into the rocky wall at intervals to facilitate the attachment of the hauling cable. Even then the engineer has to keep his steam pressure to its maximum, and the propelling machinery is driven at its hardest, producing a roar and screeching which is indescribable, while the shower of sparks and smoke belched from the funnel testifies to the enormous strain that is being imposed upon the engines of the craft, which vibrates from stem to stern like a leaf.

The descent through the canyon is even more dangerous. The pace of the water is greater than that of the boat, even when the river is in its quietest mood, so the captain holds his craft in check by driving the propellers hard astern while drifting forward, until he has cleared an awkward bend, when he steams hard and straight ahead. But the risk is so great that many captains will not incur it, and consequently "line-down." They turn their boat round and enter the canyon stern first, with the propellers revolving in the direction necessary to propel the vessel upstream. The cable is paid out slowly, so that the boat descends gradually. As may be imagined, the strain upon the cable is tremendous, and it groans and creaks ominously. The greatest peril the pilot has to fear is being caught unawares by the raging waters, and being swung round broadside to the river, so that his boat becomes wedged between the two walls, thereby damming the channel. When this occurs the fate of the boat is sealed, for the water piling up on the upper side pours over the deck, heels the craft over,

and completes the disaster by breaking it in two. More than one boat has been wrecked in this manner, and the death-roll of the canyon has assumed such proportions that the captains decline to accept the risk of carrying passengers through, except when the river is exceptionally quiet, there being a portage whereby the lower level can be gained on foot in safety.

Even the Indians dwelling on the banks of the river—and their quaint villages are strung in a continuous line between the coast and Hazelton—dread its turbulence, erratic currents, and lurking dangers. The numbers of red men, expert canoeists, who have entered the happy hunting-ground via drowning in the Skeena run into hundreds. Here and there the totem poles give sad evidences of the fact, for many have been notched to the utmost limits, each cut commemorating a fatality in the river. There is an Indian cemetery near the canyon on the outskirts of an Indian village, and I was informed that one of the most imposing totem poles is notched so thickly on either side as to defy counting almost. An aged member of the aboriginal community residing here has been deputed to perform this gruesome task, and he has cut over 60 notches, each representing a victim, during his term of responsibility.

Accidents to the boats occur with startling frequency, and often the contractors have had their transport arrangements brought to a standstill through every vessel being *hors de combat.* Grounding is the most common cause of accident, for in the rush to keep the camps well equipped, the captains take long chances, and often endeavour to push the heavily laden boat through stretches of the river when the water is too shallow, and as a result of this abortive effort have huge rents torn in the hulls. Propeller troubles are almost of daily occurrence, for it is nothing for a boat to lose all the paddles from one of its stern wheels against a rock. When I came down the river three out of the five boats were thrown out of service. We passed one vessel

drawn into the river-bank where the crew were toiling might and main to replace the paddle-blades of a stern-wheel, which had been trying conclusions with a submerged rock, and had fared worst in the process. Owing to the number of accidents to the craft, the contractors have provided a slip at Prince Rupert, whence the derelicts are towed to have any damage repaired, and it is very seldom that the slip is not occupied. The Hornet's Nest is the point where the captains invariably meet with accident, especially during the month of September, when only a few inches of water cover a veritable *chevaux de frise* of sharp rocks.

River transport comes to an end in November, when the river freezes over, and during the ensuing six months nothing can be sent up the waterway, which is not released from the iron grip of winter until May. The interior is cut off from the coast during that period, the sole means of transportation being by dog-train, which is pressed into service for the conveyance of first-class mail.

When the contracts for construction were let the Grand Trunk Pacific Company made it a part of the undertaking that the vessels they had acquired and used on the waterway should be purchased. Their experience with the treacherous waterway had been so unfortunate that they declined to operate them further. As means of transportation were vital to the building engineers, who have over sixty camps strung out along the river between the coast and Hazelton, and as it was imperative that construction should be undertaken simultaneously at forty or fifty different points, the three craft were taken over and the fleet augmented by two additional vessels. Even when the whole flotilla is in service and the river is on its best behaviour, it is only by Herculean effort that the needs of the constructional army, numbering between 3000 and 5000 men, together with about 1000 teams, scattered along the river, can be stocked adequately with supplies to

meet demands during the six months the river is closed to navigation.

The line does not run directly into Hazelton, but, leaving the river about three miles below the town, strikes slightly inland, following the course of the mountain range, skirting Mount Hazelton and the peaks beyond, until it gains the point where it becomes necessary to delve through the barrier, in order to emerge into the valley leading to Aldermere. Hazelton is linked with the coast by means of the telegraph, a spur having been carried from the Yukon system to Prince Rupert, when that town was established. This line follows a difficult course through the mountains, but as the grade has been advanced along the river-side, the Grand Trunk Pacific telegraph line has been built simultaneously alongside the track, and in due course will displace the former Government connecting link. The contractors built a telephone connecting Hazelton with their camp at Sealeyville, three miles below, to secure connection with the telegraph system, so that the forces at the front could be kept in touch, when the elements so permitted, for the storms play strange pranks and sad havoc with the slender telegraph wire, with the base at Prince Rupert.

The investment of capital necessary to commence constructional operations upon this mountain section was enormous. In the first place each of the fleet of steamboats represented nearly $200,000, or £40,000. The camps cost from $2000 to $6000—£400 to £1200—apiece to instal, and as these are spaced from one to two miles apart, the outlay in this direction alone aggregates a large sum. Each of these centres had to be stocked with provisions and other supplies, and the outlay in this direction totalled over $4,250,000, or £850,000. Consequently, before the contractors were able to move a shovelful of earth, or to fire a single blast, they had to sink considerably more than $6,250,000, or about £1,250,000. And this for less than 200 miles of railway!

CHAPTER XXI

THE CONQUEST OF THE CASCADES

DESPITE the rugged contour of the bank of the Skeena River which the line follows, the engineer has plotted a route free from sharp curvature and adverse grades. The location runs round the bases of the mountains about 20 feet above high-water mark. The indentations have been ignored, the line striking directly across the arms of water upon a solid rock embankment. Similarly, spurs have been pierced where they projected into the river. Every subterfuge to which Nature appeared to have resorted, in order to thwart the railway surveyor, has been broken down or overcome.

Nature, however, has wrought her revenge. To achieve the engineer's desires, money has had to be expended lavishly, and he has been forced to engage in stiff, uphill battles. For the first 60 miles it was only by the aid of explosives that the grade could be driven forward—there is not a foot of what is known as " surface line." The engineer has had to trim back the mountains where they kiss the river, hewing a narrow shelf out of the solid rock. It was work which demanded the finest skill on the part of the rock-drillers and blasters, for advancing through such material forms the most expensive form of railway construction, and progress was reduced to a mere crawl, relatively speaking.

When it was realised that explosives would have to be consumed upon an unprecedentedly heavy scale, the contractors were forced to extreme measures. Everything had

to be brought by water from Vancouver, 550 miles to the south, and powder and dynamite are cargoes which have to be handled with infinite care and demand compliance with certain forms of legislation. They came to the conclusion that it would be cheaper, more expeditious, and more satisfactory if the constituents of such agents were brought up in their raw condition, thereby avoiding compliance with irritating legal enactments which invariably spell delay, as well as expense, and were mixed and combined to form the resultant devastating material on the spot. As a result an explosives factory was established near Prince Rupert, where tons of this material were manufactured every day, and by means of the steamers distributed among the various camps.

The constructional engineers even went further. They knew from prolonged experience the profound contempt with which the rock-borer regards this terrible splitting medium as a result of extreme familiarity therewith, and consequently they set up a special mill for the production of " Virite." This is much safer to handle than dynamite, but is very powerful, and meets with the requirements of the rock-worker to a complete degree, since it breaks up the rock well. However, dynamite and common black powder were manufactured as well.

A friend of mine recounted an experience on the Skeena River which to him was decidedly uncomfortable, and which served to illustrate the supreme contempt with which those who are brought into daily contact with explosives regard these devastating agents. He was bound for Hazelton on one of the contractor's river boats, and when they called at Port Essington they found a sister craft laden to the water's edge. Its machinery had broken down, and as it was urgent that she should proceed up the river without delay, as she had urgent stores aboard, including a large consignment of black powder and dynamite packed on the open deck, towing assistance was requested.

THE ENGINEER'S CONQUEST OF THE CASCADE MOUNTAINS

By hugging the base of the mountains along the Skeena River the engineer has completed an unparalleled achievement. He has built an absolutely level line for over 60 continuous miles through the most difficult part of the range.

Evidences of the dangerous cargo were evident, for little trains of black grains which had made their way through cracks and crevices in the boxes were scattered around.

The disabled vessel was taken in tow, the derelict being but a few feet behind the leader. To my friend's consternation and disturbance of peace of mind, he observed that the crew of the second vessel were walking among the dangerous contents smoking with as much impunity and equanimity as if the boxes carried nails. He shivered appreciably, and walked to the bow of his boat to shut out the sight. As they were wending their way slowly through one of the difficult stretches of water, curiosity provoked him to have another glimpse of the vessel astern. He received a more startling shock, for the effort of proceeding through the troubled waters was so great, that the leading craft was belching dense clouds of live wood ashes and cinders, and these were raining around the bulk of explosives on the second vessel. One of the rock-borers was aboard, and my friend drew his attention to the danger of an incandescent piece of half-burnt wood falling among the little black grains distributed around the boxes. The workman shrugged his shoulders disdainfully, and then remarked: "Well, if that lot does flare up, I guess there'll be something doing!"

This is the rock-borer's characteristic demeanour. To him the possibility of the mass exploding under the action of an unlucky hot cinder falling in the critical spot was no worse than driving a pickaxe into a misfired dynamite cartridge in a rock-cut. The result in either case would be the same—devastation, death, and agony on all sides. But he saw no need to reduce the liability of the accident, and my friend admitted that he had never breathed so freely in his life as when he saw the boat with the dynamite and black powder aboard cast off astern.

Some of the rock-cuts through the projecting spurs are of prodigious dimensions. From the centre of the waterway

they appear mere trenches through mole-hills, but when one walks along the permanent way their true proportions loom up with convincing impressiveness. The slope on the off-side tumbles abruptly into the water, while, on the other hand, the wall of rock slants up for a height of 150 feet before it cuts the profile of the mountain shoulder. Then in point of length some of these cuts approach 1500 feet. At places it appears as if the obstruction could have been negotiated more easily and cheaply by resource to tunnelling, but the adoption of this solution has been reduced to a very insignificant degree. The first tunnel is at mile 52 out of Prince Rupert, and that is a trifling undertaking of its class, being only 420 feet in length. Had it not been for the fact that it runs through a high shoulder, a surface cut would have been made.

The rock was found to be extremely hard at places, progress was necessarily slow, and the boring tedious. There is one cut measuring 6600 feet in length, which occupied no less than twenty-six months to complete. The drawback to work of this nature was the relatively small number of men that could be crowded upon the operation, since the working face was of small area. This disadvantage was mitigated so far as practicable by distributing the drillers over a certain area, so that the rock could be attacked simultaneously at various points from the upper surface.

In places, however, drilling was an exciting and perilous operation. Where the rocky wall rose up almost vertically from the water's edge, the men plying the drills were slung on crazy footholds, secured to the rock face by planks and logs held in position by a length of chain and iron dogs driven into the wall. In these cramped quarters careful movement was essential to avoid sudden acquaintance with the raging waters below, for the precarious scaffolding was but two feet or so in width. On other occasions, where the rocky barrier was not so steep, the men chipped out little standing spaces around the drill, and were steadied in their

movements by ropes trailing from above, and secured to leather waist-girdles. When the drilling had been completed, and the charges had been tamped home, the men were hauled up the face of the rock to retire to a safe distance while dynamite and powder completed its splitting work.

Where the character of the mountain profile did not admit of such scattered attack, as in the cuts approximating 150 and 200 feet in depth, the men had to drive their way forward from either side of the obstruction in just the same way as if they were boring a tunnel. Then the rate of advance slowed down very appreciably. The drills employed varied according to the prevailing conditions. The Rand drill was that most generally used, and was operated by either steam or compressed air, according to which was the most convenient form of energy, the drills being adapted to both descriptions of power. Where the space in which the men had to work was unduly cramped, such as on steep slopes, and the handling of the power plant was somewhat difficult, the ordinary type of hand-drill was pressed into service. Directly the conditions permitted the former tool being brought into service, however, it was adopted, for such expedited the drilling task to a very pronounced degree.

The section of the mountains which offered the sternest resistance, and where the resources of the engineers were taxed to a superlative degree, was over the first 100 miles, especially in the vicinity of Aberdeen. The quantity of dynamite, black powder, and "Virite" consumed was tremendous. To fashion the permanent way between Prince Rupert and Kitselas Canyon over 2,000,000 shots, as blasts are called, had to be fired, varying in proportions from small puffs removing a ton or two of rock to mighty upheavals which broke up a whole hill-side. It was by no means uncommon on the lower stretches of the river, where the rock-work was heaviest, for explosives to the value of

$2500 to $5000—from £500 to £1000—to be consumed in a single blast.

On such occasions the spectacle was magnificent. The massive hump of solid rock was honeycombed with drill-holes, and the charges were tamped home. The men upon the warning blast of a hooter retreated a considerable distance behind the operator entrusted with the firing of the shot. Electrical detonation was adopted, the spark being produced by a small hand-dynamo similar to that employed for testing electrical lighting circuits in buildings. The dynamo emitted a peculiar droning, and almost instantly puffs of smoke were to be observed spouting from all sides of the hump, culminating in a huge plume formed of rock, dust, and smoke, which rose majestically into the air. Then there was a reverberating roar, followed a few minutes later by the long-drawn-out crash of disintegrated rock as it pattered down the hill-sides, or tumbled into the river with an inspiring crash. Where the huge hump had towered a few minutes previously, but a dishevelled pile of broken rock was to be seen strewn in all directions—a massive monolith of solid rock, representing several thousand tons, had been shivered as completely as if it were glass.

By the time that Kitselas Canyon was reached over 10,000,000 pounds of explosives had been consumed, so that it may be seen that this agent was used with striking prodigality. Over a million dollars, or £200,000, vanished literally in smoke, but in so doing it tore out and pulverised millions of tons of rocks. When the work was in full swing, the reverberations of the blasts rolled so continuously up the river during the day that from the distance it sounded as if a terrific bombardment were in progress.

It says much for the skill and care with which this work was carried out that the number of accidents attributable to blasting was insignificant. Now and again the men in their haste to return to the attack with their drills did not

THE RAILWAY BUILDER'S HEAVY ARTILLERY

The steam shovel is one of the constructional engineer's most useful weapons. The toothed bucket scrapes up the side of the hill and removes about three tons of material with every bite.

LAYING THE TRACK BY MACHINERY ACROSS THE PRAIRIE

By this wonderful apparatus the sleepers are discharged on the grade in a continuous stream and by means of crowbars, adzes, and axes are pulled and laid in position. The rails are likewise lifted from the trucks behind and lowered upon the wooden bed.

allow sufficient time for charges hanging fire to expend their devastating effect. At others a dynamite charge would fail to explode, and the fact was not discovered until a pick was driven into the lurking danger, when death was spread on all sides with startling suddenness. While boring one of the short tunnels that carries the line alongside Kitselas Canyon three Italians met their doom in this way. But, taken on the whole, the men in charge of the blasting arrangements evinced unremitting care, for it was soon realised that killing and maiming men became highly expensive in regard to compensation, and this was a sequel which the station-man did not appreciate.

Life in the construction of this railway has not been held so cheaply as it was on earlier American railways of great magnitude. One station-man confessed to me, after a solitary, unfortunate experience that befell him in this connection wherein one or two foreigners were launched into eternity, that he had never realised the activity of consuls before, or the number of relatives these strangers from Europe possessed.

Owing to excavation being carried out entirely through rock, the contractors evolved steam-shovels designed especially for the handling of such debris, and thereby introduced a new feature into railway engineering. The enormous extent of the rock work did not permit of the usual methods of handling rock to be practised profitably, for the stone boat and wooden toboggan slide is slow. On the other hand, the ordinary steam-shovel was quite incapable of dealing with massive boulders weighing perhaps up to two tons or more. As an experiment a small 40-ton steam-shovel having certain modifications was built to ascertain its possibilities in this new field of operations. Proving completely satisfactory, larger and more ponderous appliances of this character were built and installed. The largest tools of this class are cumbersome and powerful, but they can swing $2\frac{1}{2}$ cubic yards of rock, representing from

four to five tons in weight, with as much ease and speed as the small appliances will deal with gravel and clay. At the time of my visit no less than eleven of these ungainly, powerful implements ranging up to 70 tons in weight were at work, and the speed with which they demolished the debris after a blast, loading it into capacious railway ballast trucks, was amazing.

The embankments which carry the line across the indentations are also striking pieces of work, for these bays in certain instances are of considerable width and depth, being practically submarine gorges or chasms. At times the contractors wondered if they would ever bring the stone embankment above the surface of the water, for the dump appeared to make no appreciable headway. It was as if the river carried away each truck-load as it was discharged. There is one solid embankment which is 50 feet wide, stretching across a small bay, which occupied fourteen months to complete. In another instance, when the grade commenced to cut across the break in the shore-line to gain the opposite promontory, the contractors found themselves confronted with a depth of 70 feet, and, owing to the material, as it was discharged, spreading itself out over the river-bed, many months elapsed before the water-level alone was gained.

There is no danger of the angry river, even when lashed into its most violent moods of fury, ever being able to disturb this road bed. No apprehensions regarding undermining or the results of scouring are entertained. It is far too massively and solidly constructed for that. Where the mountain flanks have been traversed the rails rest on solid rock, and as the submerged bank on the water-side is integral with the mountain, undermining is impossible. The embankments across the indents are likewise of heavy proportions, the wider fills ranging between 75 and 100 feet in width at the base, and being fashioned of heavy boulders from the cuts, are sufficiently resistant to the force of the

READY FOR TRAFFIC—A FINISHED STRETCH OF LINE

This shows the track ballasted and ready for the passage of trains. There is to be seen respectively a cutting, an embankment, a timber trestle and a tunnel. The trestle however will be filled in at a later date to form a solid earthen embankment.

current to preserve their original character intact. The grade has been pronounced by engineers as one of the most solidly constructed on the American Continent, and one also of indisputable permanency, while Mr. Stewart admitted to me that it constitutes the finest piece of work of this class that his firm has ever accomplished in the course of their construction of 10,000 to 15,000 miles of line through the American mountains.

To cross the mud-flats and lower-lying islands that are encountered above tide-water, heavy crib-work has been practised in conjunction with piling. Massive baulks of timber have been driven lengthwise into the swamp, and on this a horizontal network of heavy wooden logs has been erected, the members criss-crossing in layers, and being so arranged as to form a homogeneous, massive wooden skeleton. The spaces between were then filled up with rock removed from the excavations, the largest boulders forming the outer walls. Furthermore, where heavy scouring is likely to be experienced in times of flood, the crib-work has been protected externally by large masses of stone pitched promiscuously into the river. In due course the whole of the crib-work will be protected in this manner, so that the centre of the crib carrying the metals will be adequately protected by a sheathing of rock on either hand. At places the crib-work has been somewhat heavy, for the sloughs along the Skeena are extensive, and are subjected to heavy and continuous depletion and accretion, according to the seasons, but every precaution has been adopted to overcome any tendencies on the part of the grade to slip, sink, or to be washed out.

At Kitselas Canyon the grade is about 80 feet above the level of the waterway, and here, owing to the mountains cutting across the location at right angles, to terminate abruptly in a precipitous cliff to form one vertical wall of the channel through which the river pours, somewhat heavy tunnelling has been necessary, as the proportions of

the shoulder were too huge to admit of open cuts being made economically. There are three tunnels driven through separate spurs approximately 400, 700, and 1100 feet in length respectively, with short intervening stretches of open line on the brow of the cliff overlooking the canyon. The task of driving these works was undertaken by the contractors, and when the labour problem was eased advance was made rapidly. Their early completion was imperative, in order to connect up with the completed section of the grade on the eastern side of the canyon, and over which the forwarding of supplies could be effected, thereby avoiding the danger that the fickleness of the Skeena offers to navigation through this gorge. In this way the boats could be restricted to service east of the canyon, thereby reducing risk of disaster in an appreciable degree.

The country beyond the canyon opens out somewhat, though the river is overlooked by steep banks, and to preserve the grade considerable side-hill work was necessary. Advance, however, was effected more rapidly under easier conditions.

About 16 miles below Hazelton the river is crossed, advantage being taken of a suitable site avoiding grading and curvature, where the river winds between lofty banks, and becomes slightly narrowed. Gaining the southern bank, the grade strikes slightly inland, to meet the Bulkley River, near the point where it empties into the Skeena River. The former is not crossed, however, as the grade runs between the southern bank of the Bulkley River and the mountain range, three miles distant from Hazelton, until it enters the Bulkley Valley. Though the Bulkley River follows a sinuous course, the location has been carried out in such a way that bridging of this waterway is avoided until it reaches a point well to the south, in the valley of the river of that name.

The slight recourse that has been made to tunnelling along the Skeena River constitutes a conspicuous feature

THE BULKLEY RIVER GORGE

The railway skirts the south bank of this river, keeping to the top of the rocky cliffs, which drop sheer into the water for 80 to 100 feet. In the foreground is the wonderful Indian cantilever bridge built of tree-logs lashed together with willow thongs and wire.

of the location, and, bearing in mind the wonderful scenery that is unfolded throughout the 186 miles between Prince Rupert and Hazelton, this is a factor which will be appreciated highly by travellers. Beautiful unobstructed vistas of mountains, forest, and waterfall are obtained from the grade for mile after mile, rendering this railway journey the foremost scenic route through the mountains of North America. Hitherto the prevalent practice has been to tunnel through spurs, but on this undertaking the open cut was favoured more generally. It may seem more expensive, but, on the other hand, these served to supply the immense quantities of material that were required for filling the embankment across the breaks in the shore-line, which otherwise would have had to be obtained from other sources at heavier expense.

The avoidance of tunnelling also reduced the possibility of encountering the " unknown " to a remote degree. This difficulty was experienced only once. A tunnel through a spur was projected, but the drillers tapped a large strata of soft clay and mud. Instead of grappling with this contingency, the extent of which could not be ascertained with certainty, the tunnel was abandoned, and a deep, heavy open cutting was driven instead, which, although it entailed a slight revision of the line, proved the most economical solution of the problem, and ultimately gave a result preferable from the railway's point of view.

Here and there, owing to the steepness of the mountain flanks, snow-sheds are necessary to preserve the line from being overwhelmed by avalanches and rock-slides. But here again, owing to the skill with which the survey was carried out, these stretches have been reduced to the minimum. Certainly they are not of so extensive a character as are found on other lines farther south.

Apart from the bridging of the Skeena below Hazelton, works of this character have been neither extensive nor expensive. The tributary waterways flowing into the

Skeena River from the north are insignificant, with the exception of the Kitsumgallum River, below Kitselas Canyon, which drains the richly fertile valley of the same name. But here a heavy structure was not demanded, a simple steel bridge of the deck design sufficing to carry the track from bank to bank.

If figures afford a more graphic and convincing idea of the amount of work that was necessary to carry the Grand Trunk Pacific Railway over the 186 miles between Prince Rupert to Hazelton through the Cascade Range, then they assume huge proportions. According to the official estimates the excavation represents between 3,500,000 and 4,000,000 cubic yards of rock—the equivalent in tons would be about double that figure—and some 4,000,000 tons of gravel, loose rock, and earth. So far as the filling is concerned, about another 4,000,000 cubic yards must be taken into consideration. Broadly speaking, it may be said that over 12,000,000 tons weight of the mountains have been handled by the artillery at the disposal of the engineer to provide 100 miles of grade for the Grand Trunk Pacific Railway.

In view of such colossal work, the question naturally arises as to the cost of the operation. As might be supposed, it attains an enormous total. To overcome the most antagonistic 100 miles of the Cascade Mountains the expenditure of $8,000,000, or roughly £1,600,000, has been incurred. The average cost per mile, according to the figures extended to me, approximates $80,000, or £16,000. This sum does not include ballasting, sleepers, rails, or metallic structures, but merely represents the cost of the grade. These are truly tremendous figures, and afford one an idea as to what it means to build a first-class railway through such a formidable mountain barrier as the Cascades.

Could the work have been accomplished more cheaply ? Certainly, had the practice generally adopted in such under-

takings on the North American Continent been embraced. A line could have been built through this range for about a third of the above cost, but it would have been a railway more in name than in fact. It would have comprised the famous longitudinal ridge of earth with the metals dumped on top, with grades rising and falling like the teeth of a saw, describing the most fantastic contortions, with curves like a corkscrew, as it wound round bays up, over, or round humps.

But the first 100 miles of track along the Skeena River is the most startling and sensational expression of the surveying and constructional engineers' skill that has ever been consummated among the Cascades. For the first 60 miles, although there has been a desperate grapple with the heart of the mountains, the grade does not rise an inch. It is as level as a billiard-table. The dream of the railway manager has been fulfilled, and traffic operations will fulfil the theory advanced by the late President Cassatt that " the level line wins." The possibility of introducing even a mile of level track among these mountains, though attempted often, has proved hopeless. Yet the Grand Trunk Pacific threads the most difficult section of the journey without a rise in either direction. The heavy financial expense has been justified fully to achieve such an end. The economy possible in working expenses will more than recoup the initial outlay to secure this result. From the sixtieth mile-post—the limit of tide-water—the line has a gradual climb of 21 feet to the mile against east-bound traffic, owing to the grade of the river, but westward it does not exceed 15·84 feet per mile. The Grand Trunk Pacific Railway from the character of its location may be devoid of spectacular constructional feats, but its most outstanding feature, perpetuating a monumental achievement, is the 60-mile stretch of level grade, 20 feet above the water-line, through the tumbled and broken heart of the Cascade Mountains.

CHAPTER XXII

TRACK-LAYING BY MACHINERY

THE constructional engineer does not hand over a section of railway complete and ready for operation unless there is an express condition to the contrary. His task comprises the construction and finishing of the grade to what is known as "formation" level, which may be described as the fulfilment of the foundations ready for the receipt of the ballast, ties or sleepers, and rails. Nor is he called upon to erect metallic structures and bridges. This work is an art in itself, demanding specially skilled labour such as is not found as a rule among graders. On the other hand, he may undertake to complete any requisite masonry piers that may be necessary to carry the steel superstructure. As a rule, if the grade is interrupted by such obstructions as narrow rivers, creeks, and streams, the contractor temporarily spans such gaps with a timber trestle to meet his own requirements, and to facilitate the movement of his construction trains along the grade. Culverts, however, enter into his undertaking, and these likewise are often first in wood, heavy baulks of which, measuring 10 or 12 inches square, are used and bolted together, the permanent work being carried out subsequently at leisure.

Consequently, when the contractor retires from the field of his labours, the path of the rail is represented by a level, narrow causeway, resembling a high road when it is awaiting the coming of the steam-roller. The line of stakes planted by the surveyor on the location still extends unbrokenly along this rough highway, and indicates the centre

line between the two rails. The gauge is standard, viz. 4 feet 8½ inches, while the depth of ballast deposited upon the formation grade is 18 inches at least, and upon this the sleepers supporting the metals are laid.

The time was when any class of timber sufficed for sleepers. As the railway advanced through a new country the trees cleared from the right-of-way were sawn up and pressed into this service. On the Grand Trunk Pacific Railway, however, great stringency has been enforced in the selection of the timber and the preparation of the sleepers, so as to secure general coincidence with the requirements of a first-class railway. The timber has to be cut from sound, live trees, and must be free from such defects as large and loose knots, wind-shakes, and so forth, the existence of which impairs the qualities of durability and strength. The classes of timber available for this purpose were laid down rigorously, and comprised the following woods in the order named—oak, cedar, tamarac, Douglas fir, pine, hemlock, and, when permitted by the district engineer, black spruce could be pressed into service to meet emergencies or the dearth of the other woods. The sleepers were divided into two types, known as "first" and "second-class" respectively. The timber used in each instance was the same, only whereas those coinciding with the requirements of the first-class designation had to measure 8 feet in length by 7 inches thick and 8 inches wide across the face, the second-class ties, though of the same length, were slightly less in the other dimensions, being only 6 inches thick by 6 inches across the face. The main line is laid exclusively with first-class ties, the second-class material being reserved for sidings. In both instances, however, the ties had to be sawn or hewn with two parallel straight faces with squared sawn ends, and were required to be reasonably straight.

The consumption of timber in this direction alone has been tremendous, and represents the depletion of a huge

forest. In round numbers 3000 sleepers per mile are laid. On the Government division between Moncton and Winnipeg 6,400,000 sleepers have been used, while between Winnipeg and Prince Rupert about 7,300,000 ties are required to support the main line and the hundreds of miles of sidings. This gives a total of no less than 13,700,000 baulks of timber, representing 109,600,000 lineal feet of timber. The cost of this material has varied very markedly. On some parts of the prairie, where the expanse of rolling land is not relieved by the sight of a single tree, and where every sleeper had to be brought over several hundred miles, the cost of the baulk of timber by the time it reached the point where it was to be laid down reached 75 cents, or 3s.! On the mountain section, along the Skeena River, where an abundance of suitable wood was to be found immediately contiguous to the line, the cost averaged 35 cents, or 1s. 5½d. apiece. When it is borne in mind that the sleepers undergo no preservative treatment with creosote, such as prevails in Europe, but are delivered in the condition that they emerge from the saw-mill, wood certainly becomes an expensive factor in railway-building operations. Although Canada possesses vast tracks of forest, the inroad made upon such reserves by the railways alone attains considerable proportions. The life of a sleeper averages only six years, and consequently the consumption of this commodity by the various railways in the country attains several million lineal feet per year, merely for the satisfaction of renewals.

The consumption of steel in the form of rails to provide the track upon this trans-continental railway also has attained prodigious proportions. The rail length varies from 27 to 33 feet in length, the latter being that most generally used on the main line, while the weight is 80 pounds per yard. Extensive experiments were carried out to ascertain the weight of rail most suited to requirements, since railway practice to-day favours the 100-pound per

THE PASSAGE OF THE TRACK-LAYER

In front is the grade as fashioned and completed by the constructional engineers ready for the metals. At the right-hand side of the machine is the trough fitted with rollers in which the sleepers are whirled to the front of the train and discharged to the ground.

yard rail, but investigations proved that the 80-pound rail could withstand the severe climatic and temperature variations to the most satisfactory degree. On the Government moiety of the undertaking 268,022 gross tons of rails have been used, while on the Grand Trunk Pacific division the amount of metal required for tracks and sidings approximates 272,000 gross tons—a total of over 540,000 tons of steelwork in this one direction. The greater bulk of this supply has been derived from the mills of the Dominion. In regard to the Skeena River section the remoteness of the locality proved a heavy handicap somewhat, inasmuch as such material had to be conveyed by water, entailing the protracted voyage round Cape Horn.

But the huge distances that have to be covered in Canada and the vast amount of track-laying that has to be carried out has brought about a decided improvement in the methods of accomplishing this operation. Instead of resorting to hand-labour, with all its fatigue, expense, and relatively slow progress, ingenuity has devised a mechanical means of accomplishing this work. The metals are laid at the rate of two or three miles per day by machinery.

The track-layer is one of the most interesting tools with which the railway-builder carries out his epoch-making work. It is a cumbersome, ungainly, and fearsome-looking implement, but with a convincing, grim, business-like appearance. From the front it resembles a gallows, and for this reason has earned the sinister sobriquet of " the gibbet " among certain members of the engineering fraternity. On the front of the truck there is a lofty rectangular scaffolding of rigid construction, strongly braced and supported for the hard, heavy work it has to perform. A jib runs forward into the air from the bottom of either leg to meet at the outer extremity and to form a derrick. The car on which this structure is mounted carries a number of small steam-engines, each of which has to perform a particular function, while at a commanding

point high up on the rectangular construction is a small bridge, from which the man in control of the machine carries out his various tasks and controls the whole mechanism. Ropes, hooks, and pulleys are found on every side, and though, from the cursory point of view, it appears an intricate piece of mechanism, yet its operation is absurdly simple.

This machine constitutes the front vehicle of the train, with the bridge facing the grade and the projecting boom overhanging the track. Immediately behind are several trucks piled with steel rails, fish-plates to secure connection between successive lengths of rails, spikes, and other necessaries. Then comes the locomotive, followed by a long train of trucks laden with sleepers. On the right-hand side of the train, level with the deck of the trucks, extends a continuous trough, with its floor consisting of rollers. It reaches from the rearmost car in the train to 40 or 50 feet in advance of the track-layer, the overhanging section being sustained by ropes and tackle controlled from the track-layer truck whereby the trough can be raised and lowered as desired.

The appliance is operated as follows. The engine pushes the fore-part of the train slowly forward until the end of the rail last laid is approached. The rollers in the trough, which is in reality a mechanical conveyor, are set in motion. Then the gangs of men stationed on the rear trucks with might and main pitch the bulky sleepers into the trough. Caught up by the rollers the ties are whirled along to the front of the train, and tumble to the ground in a steady, continuous stream. As they emerge they are picked up by another gang of men who roughly throw them into position on to the grade. Other members of the gang, equipped with axes and crowbars, push, pull, haul, and prise the ties into their relative positions and at equal distances apart.

When twenty or thirty sleepers have been deposited in this manner, a pair of steel rails are picked up by booms

from the trucks behind the track-layer, are swung through the air and lowered. As they near the ground ready hands grasp the bar of steel, steady it in its descent, and guide it into its correct position. The gauge is brought into play dexterously, and before one can realise what has happened the men are spiking the pair of rails to the sleepers, have slipped the bolts into the fish-plate connecting the new rail to its fellow already in position, and the track-layer has moved slowly forward for some 13 or 16 feet over a new unit of track, meanwhile disgorging further sleepers from the mouth of the trough.

The noise is deafening, owing to the clattering of the weighty baulks of timber racing over the noisy rollers in the conveyor, the rattle of metal, and the clang-clang of the hammers as the men with powerful strokes drive home the spikes fastening the rail to its wooden bed, and the hissing and screeching of steam. Amid the silence of the wilderness the din created by the track-layer at work is heard for some time before you can gain a glimpse of the train. The men speak but little, for the simple reason that they could scarcely make themselves heard if they attempted conversation. Each moves with wonderful precision, like a part of an intricate machine.

In this way the rail creeps forward resistlessly at a steady, monotonous pace. The piles of sleepers and rails on the trucks disappear with amazing rapidity, and the men engaged in the task of charging the conveyor-trough and swinging the rails forward, appear to be engaged in a mad race with steam-driven machinery. The perspiration rolls off their faces in great beads, and they breathe heavily as they grasp and toss the weighty strips of timber about as if they were mere straws. There is no pause or diminution in their speed. If they ease up at all the fact becomes evident at the front in the course of a few seconds in a unanimous outcry from the gangs on the grade for more material, which spurs the lagging men on the trucks behind to further

effort. The only respite from the exhausting labour is when the trucks have been emptied of rails or sleepers and the engine has to run back for a further supply, or when the hooter rings out the time for meals or cessation of labour.

The track-layer at work is the most fascinating piece of machinery in the building of a large railway. The steam-shovel may be alluring, and the sight of a large hill of rock being blown sky-high may compel attention, but it is the mechanical means which have been evolved to carry out the last phase—the laying of the metals—that is the most bewitching. One can see the railway growing in the fullest sense of the word—can see the thin, sinuous ribbon of steel crawling forward over the flat prairie, across spidery bridges, through ravine-like rock-cuts, gloomy tunnels, and along lofty embankments. Now and again, when the apparatus has secured a full complement of hands, and every other factor is conducive, the men will set to work in more deadly earnest than usual, bent on setting up a record. Races against time have become quite a craze among the crews operating the track-layer on the various railways throughout America, and consequently the men allow no opportunity to set up a new record, when all conditions are favourable, to slip by.

The work, however, is not without its tragic, adventurous, or comedy side. One of the men who had operated this machine upon half a dozen different big railways between the Gulf of Mexico and Alaska related a thrilling few minutes that were encountered among the mountains farther south. The track-layer was crawling round the shoulder of a big mountain. It was early spring, and the snows had not all disappeared, though the days were warm. Suddenly above the din created by the machinery in motion a dull, strange rumble was heard. The man on the bridge glanced up the mountain-side, and, to his horror, saw a mass of rock, trees, snow, and other debris quivering. The movement was taking place immediately above them,

A Land Slide

The movement is brought about by rain, springs, or natural settlement. Huge masses of the bank, representing several thousand tons, will move bodily, sweeping everything away. The cleft in the trees represents the clearing for the railway right-of-way.

and, what was worse, the track-layer lay right in its path. There was no time to back the train, so with a frantic yell he stopped his machine, dropped down on the deck of the truck, and pointing up the mountain to his comrades, jumped to the ground, and ran as fast as his legs could carry him along the grade, giving warning as he went. The men abandoned their tasks hurriedly, and likewise took to their heels. Soon over 130 men were skeltering along the uneven track at desperate speed.

Every one reached safety as the rumbling and rolling increased in volume. It appeared as if the top of the peak had been displaced and had been sent careering down the mountain slopes. Trees, rocks, and earth were flying in all directions. The train was seen to quiver; there was a twist and a savage wrench. Running to the side of the grade, the gang saw the track-layer and one or two laden trucks rolling over and over into the ravine.

When the avalanche had passed the men returned to the front, found the track piled up with debris, obliterating the path for the metals for a considerable distance, while down in the gulch below could be seen wheels and ribs of the track-layer projecting from the dishevelled pile of rubbish scattering the mountain-side in all directions. It looked a fearful and hopeless wreck, but while the graders were striving to re-shape the grade, the track-layer crew, by means of ropes and tackle, retrieved the greater part of their dismembered friend. By dint of a few weeks' hard and continuous work it was restored to working order completely. It was a narrow escape, and it was fortunate that the man on the bridge happened to observe the coming catastrophe when he did, or there would have been an appalling death-roll.

When the track-layer has passed, the line presents a somewhat bedraggled appearance. The sleepers are symmetrical and the line is true to gauge, but it is twisted as strangely as if it had been writhing and doubling under

the influence of tremendous heat. In this skeleton form, however, it is passable, and so long as trains proceed carefully and slowly is useful for traffic. Certainly it offers a means of enabling supplies to be forwarded more expeditiously to the front than other methods of transportation.

The track-layer not only constitutes a material time-saver, but it also represents a valuable economiser in labour. True, the crew necessary to secure its maximum efficiency is a large one, but when one bears in mind the great exertion and large corps of men that are required to lay a mile of track in the same time by manual effort, its advantage is overwhelming. When fully manned the track-layer absorbs 150 men, and when the conditions are favourable, such as on the rolling prairie, and the going is free from all hindrances, between three and four miles of track can be laid in a day. The average, however, ranges between two and three miles per ten-hour day. Even on the Skeena River division it has been found possible to lay two and a quarter miles of track in this time, while two miles is a very fair average, and, considering that there the conditions are not favourable to high speed, this result is eminently satisfactory. On this mountain section the rate of progress has been retarded by the delay in replacing the temporary wooden bridges across creeks and streams erected by the contractors for their especial benefit by the permanent steel structures, for, owing to the weight of the track-layer and its train, the former structures cannot be traversed in safety.

Galicians have proved to be the best type of labourer for working this machine. They toil along steadily and persistently for hour after hour without showing any signs of fatigue, while their powerful physiques stand them in good stead in handling the bulky, heavy ties, and in wielding the ponderous hammers used for spike-driving. The scale of wages varies considerably, according to the character of the

country in which work is being carried out, and, parenthetically it may be mentioned, as to whether there is a plentiful supply or dearth of men. On the prairie section the track-layers received on the average 15 cents, or 7½d., per hour, but on the Skeena River twice this rate prevailed, making $30, or 12s. 6d., per day, and even then sufficient men could not be obtained to man the machine fully.

In due course the alignment and levelling of the track is carried out, for the skeleton line follows all the inequalities in the surface of the grade, and consequently riding over such a line is a somewhat painful experience. The ballast trucks are large, capacious waggons with bottom hopper doors. The train draws over a section of the skeleton line, and the contents are dumped in a ridge between the rails. At the end of the train is the ballast distributor. This is a flat deck truck carrying beneath the body and between the wheels a double plough, each edge of which is concave, and the arrangement of which is such that the two edges form a horizontal triangle with the point facing the front of the train. The outer edges of the plough project slightly over the metals on either side, while it can be raised and lowered vertically by means of a wheel on the deck above.

After the ballast has been dumped, and as the train moves forward, the operator of the plough sets the appliance so that the edges almost glide along the surface of the rails. The prow or nose of the plough striking into the ridge of ballast forces the earth along the concave scoops to either side, so that the material between the rails is smoothed evenly, while the superfluous ballast is distributed regularly on either side of the track covering the ends of the sleepers. By means of this simple system several miles of track can be ballasted in a single day, and the mechanical distributor performs its work in every way as efficiently as manual effort equipped with shovels.

Ballasting completed, the alignment, straightening, and lifting of the track is completed. The men, a typical plate-

laying gang, lift the line bodily in short sections at a time. A small space is excavated beneath the end of a sleeper and a screw-jack is introduced. When this is brought into play the powerful force it exercises prises up a long length of rail and sleepers together to a height of as many inches as may be required. When the desired level is secured the other members of the gang perform what horizontally trueing movements are requisite, test up with the gauge, and then by the aid of the shovel pack the ballast beneath the lifted section of line to keep it in position. At the same time the spiking is completed. The rails are not chaired to the sleepers, as is the practice in Europe, but are clamped to the sleepers by huge nails having a square, overlapping head which, when driven home, grips the bottom flange of the rail. The latter rests on a tie-plate, a small, rectangular, thin plate of steel, which forms a cushion between the rail and the timber beneath. In the early days the rails were spiked directly to the wooden foundation, with the result that the sleeper was soon destroyed by the action of the rail biting and sinking into the wood under the superimposed weight of a passing train.

Lifting and aligning may have to be carried out periodically for some time after the track is laid, in accordance with the movement and settlement of the grade and ballast. When the grade has become thoroughly homogeneous and the track has bedded down the plate-laying gang make a final inspection. Then the last dressing of ballast, generally a fine material, is administered and laid to the level of the rail. The result is the production of a track as smooth and level as the proverbial billiard-table, ready for the heavy, galloping expresses.

CHAPTER XXIII

THE WONDERS OF BRIDGE-BUILDING

ALTHOUGH the massive, lofty creation of steel springing across the mighty St. Lawrence in a single span dwarfs all other erections of this character upon this railway, the thought must not be entertained for a moment that there are no other bridges of importance scattered along the 3543 miles between the Atlantic and Pacific seaboards. Such is far from being the case. There is more than one gap, the crossing of which has occasioned the engineers endless anxiety, has bristled with peculiar difficulties, and which has enabled success to be achieved only at the expense of exciting and thrilling adventure.

Upon the national section of the railway the quantity of steel that has been absorbed for structures of this description attains a huge total. There are no less than 240 steel bridges of various types, exclusive of that spanning the St. Lawrence, between Moncton and Winnipeg. Some are insignificant pieces of work crossing high roads or small creeks; others are lofty, slender-looking viaducts, while here and there is a massive piece of engineering where an abnormal obstruction has had to be negotiated. In the division approximating 200 miles in length stretching westwards from Lake Abitibi in the heart of New Ontario there are fourteen of these structures, among which are seven within a few miles aggregating 3200 feet, one being 700 feet in length, while five others are each 500 feet from end to end.

The heaviness of this work, as already mentioned, arises

from the fact that the railway cuts across the watershed at right-angles to the direction of the waterways which pour into James Bay. The most important are the Moose and the Abitibi Rivers, whose waters mingle near the estuary. These waterways are fed by a network of tributaries, spreading through the land like enormous tentacles, each of which constitutes an imposing stream in itself. In its westward journey the line crosses in turn the Black and Frederick House Rivers, forming the Abitibi River ; a little later the Mattagami, Kapuskasing, forming the eastern arm of the Moose River ; and beyond the Opazatiki and Missinaibi Rivers, forming the western arm of the Moose River. The numerous waterways swelling the Albany River, which also empties into James Bay, are encountered farther west. Under such circumstances extensive and heavy bridging was unavoidable.

The bridges that are required in this short section of line are massive, owing to the configuration of the country. The unstable nature of the river-beds has required the foundations to be carried down to great depths, while the velocity of the water during the flood season has compelled the construction of heavy, solid piers wrought in concrete. The presence of these waterways retarded construction very appreciably, once the contractors secured ingress to the country. For instance, although it was found possible to erect a temporary timber trestle across the Frederick House River for purposes of grading on the opposite bank, the bridgework being carried out later, when the Mattagami was gained, a few miles beyond, a halt had to be called until the steelwork was erected. Yet the Frederick House River is by no means an insignificant stream. It is about 200 feet across, and has demanded a steel structure over 300 feet in length by 75 feet high above the level of the water. In comparison with the Mattagami River, however, it is but a creek, for this waterway is fully 600 feet wide at the point where the railway crosses, while its depth may be judged

from the fact that it is navigable to large vessels. Were it not that falls and rapids are found on its lower reaches, it is quite possible that vessels before now would have penetrated this hinterland from the northern seas, even if it had been only for timber. Again, owing to the velocity of the water, the execution of the subaqueous work was protracted to an appreciable extent.

An outstanding piece of bridging work on the Government section is the Cap Rouge viaduct carrying the line across the valley of the same name. From end to end it measures 3345 feet, and is of the single-track deck type. When one is standing at the loftiest point of this structure, the water rolls 173 feet beneath one's feet. In no place, except at the respective ends, is the height less than 100 feet. Altogether some 4500 tons of steel were worked into this viaduct, which comprises thirty-three spans measuring 40 feet in length, twenty-nine spans 60 feet in length, and three spans of 125, 150, and 160 feet long respectively, carried on thirty-two towers. At the base the latter vary in width, according to their height, from 24 feet 4 inches, tapering to a width of 9 feet at the top deck on which the sleepers are laid. The towers rest on concrete pedestals, being anchored in position by means of bolts $2\frac{1}{4}$ inches wide by 11 feet long.

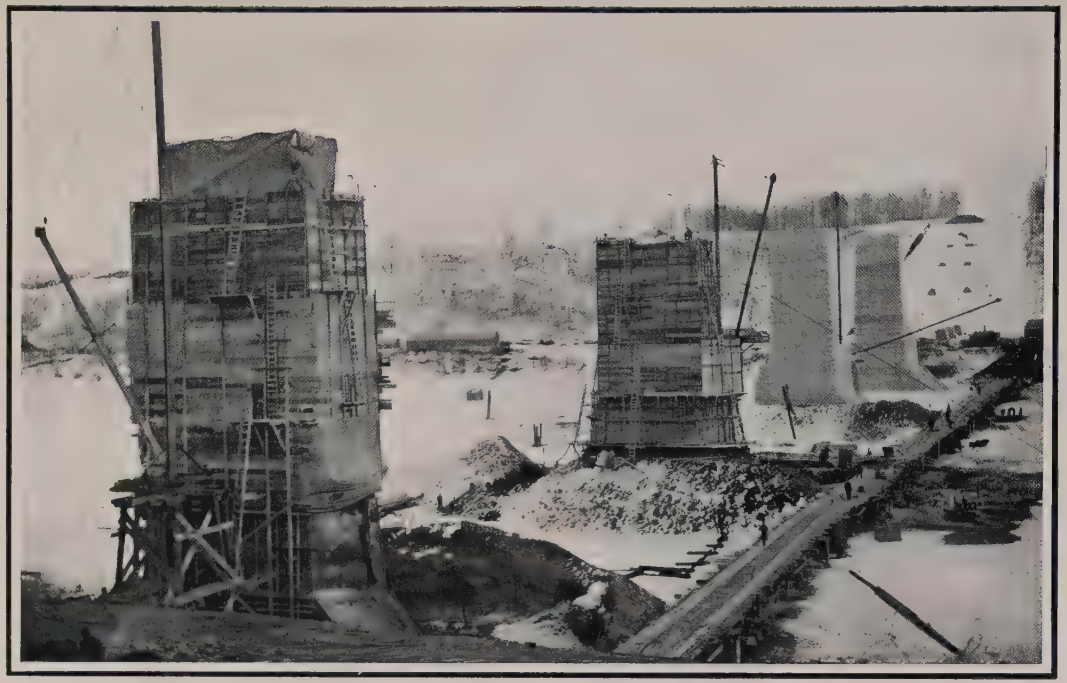
Conspicuous among the expert men engaged in this class of work was an unusual type of labour—the Red Indian. The transformation of the native from a hunter obeying no behests but his own, to a mere unit wielding a hammer or performing other unskilled labour under the eyes of a querulous foreman is indeed remarkable. Yet the engineers assured me that as workmen they could not be excelled. True, the Eastern Indian is a more industrious type than his fellow-tribesman on the Pacific Coast, and he appears to possess a keener intellect. The ease with which he had been drilled into the utilisation of tools offered convincing testimony to the fact that, handled in the right manner, the

Indian can be wrought into a useful member of the community.

In bridge-building their clear-headedness, agility, absence of fear, and physique stand them in great stead, so I was informed. Certainly they appeared to be eminently adapted to waiting upon the highly trained men who specialise in this class of erecting work, and had accommodated themselves in no mean degree to the hustle incidental to the wider resort to machinery, with its striking labour- and time-saving factors. Nor do they appear to be frightened easily or to suffer from the effects of superstition. On the Mattagami bridge, when I visited the country there were about a dozen or so of these red men busily at work. A large number had been brought up from Quebec, and were labouring on the huge St. Lawrence bridge at the time it collapsed and tumbled into the river. They had been hurled into the water below, but regained the bank little the worse for their adventurous immersion, and certainly were not to be turned from the path of their labours by the fear that another similar disaster might attend their industry in the same field elsewhere.

So far as the western section is concerned the Grand Trunk Pacific was confronted with a heavy bridge before it emerged from Winnipeg. The grain city terminus is situate on the eastern bank of the Red River, the Government having decided to stop at this point, thereby avoiding the bridge, the erection of which was left to the second party to the bargain. This structure is about 712 feet in length, consisting of four spans, each measuring 150 feet, and a short approach span at either end. Again, before the line of demarcation between the prairie and mountain divisions is gained at Wolf Creek four huge bridges have to be crossed. Each compels attention, for each possesses some striking feature of individuality.

For instance, at Saskatoon, where the line swings across the South Saskatchewan River, the width of the waterway



BUILDING THE CLOVER BAR BRIDGE

In order to cross the North Saskatchewan River at Clover Bar, to approach Edmonton, a huge bridge was required. The piers had to be of huge proportions, as the bridge had to be carried 136 feet above the water. The piers are among the largest that ever have been built in concrete.

has necessitated a structure 1530 feet in length. Projecting above the waters of the river are seven large piers to support eight spans of steel, of which five measure 225 feet apiece in length, one 150 feet long, with approach spans at either end, the rail level being 71 feet above the waterway.

In due course the North Saskatchewan River has to be crossed in order to gain access to Edmonton, the point at which the waterway is negotiated being Clover Bar, whence the bridge takes its name. At this point the powerful eroding potency of the Western Canadian river is illustrated very forcibly, for the bridge carrying the track in the preservation of the grade had to be half as long again as the river is wide. Whereas the water flows between banks 1000 feet apart, the creation of steel stretches for a length of 1663 feet. It is divided into eight spans. The dimensions of the piers which support this bridge, however, constitute the most outstanding feature. They rise up from the water like massive monoliths, and rank among the largest piers that have ever been wrought in concrete for bridgework. The abutments, or shore-supports, of the steelwork are likewise massive creations of masonry, the fashioning of one having required 5000 cubic yards of concrete.

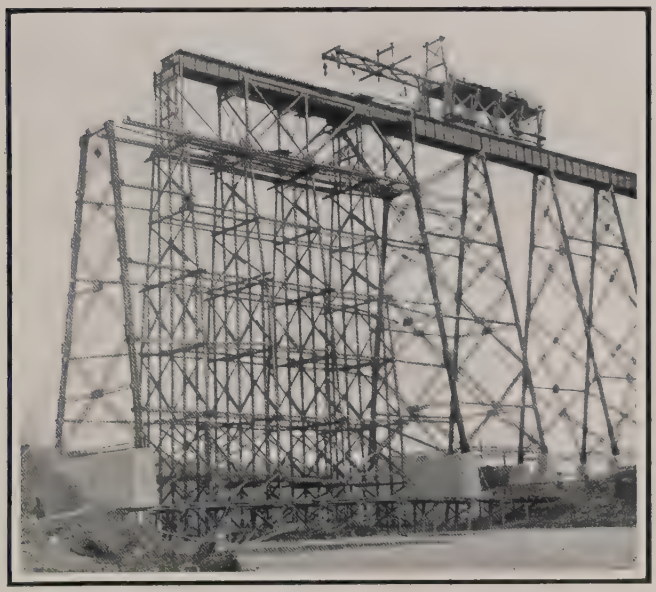
Work was commenced when the river was at its lowest level, an area being enclosed around the sites for the piers from which the water was pumped, thereby allowing the men to work in dry soil. A gangway was laid from bank to bank providing access to the erecting sites, while a small, shallow-draught steamboat served to transport the material from point to point. During the winter the ice constituted the working platform, and provided facilities for conveying the thousand and one necessities that were required, the method of conducting operations being to push forward the foundations when the river was low by cramming on every available workman, so as to rush the superstructure to a point well above flood-level by the time the winter

broke. It was an inspiriting race against time, especially as the flood season approached, for then every minute counted. When the piers had been carried to a height of 136 feet above the water, the setting of the steel was hastened forward. Timber false-work was built up, and thereby each span was handled in turn.

In the stretch of country lying between the two arms of the Saskatchewan River another fine piece of steelwork has been carried out. This is the Battle River Viaduct near Battleford, 10 miles west of Wainwright. The railway winds round the brow of a hill from the base of which rolls a fertile basin carrying the Battle River. The river itself is not very wide at the point of crossing, though it runs rather rapidly, but the valley shelves away to such a depth and so gradually, that in order to maintain the grade from one edge of the depression to the other, a steel structure $1\frac{1}{4}$ miles in length became necessary. According to the first location the viaduct was somewhat longer, but three revisions served to reduce the length of requisite steelwork, at the same time easing the curve by which it is approached. When the train is in the centre of the structure and immediately over the river, the waters of the latter tumble along northwards 185 feet below. Some idea of the great height of the structure is afforded by a glance at the telegraph posts below, which, following the contour of the land, appear like matches set out in a long single row, while when the train is viewed from the river-bank it has a toy-like appearance, and the men engaged in painting the steel resemble flies. As one descends the winding high road leading from the top of the hill to the water-level a magnificent broadside view of the viaduct is obtained. The latticed steel columns resting on the solid concrete pedestals, and supporting fifty-four spans, have a slender, albeit symmetrical, appearance, but one which from the distance looks far too frail to support the weight of a train. It is only when one gains the river

"Muskeg-Filler" at Work

The above tool is a kind of scraper carried at the front end of a long four-wheeled carriage. The mules are harnessed on either side of the beam connecting the front and rear pairs of wheels, and push the material scraped up by the forward edge to the spot where filling is required.



Setting the Bridge Span in the Battle River Viaduct

This part of the structure was erected by scaffolding, the river being crossed in a single span. The support on either side is carried upon a solid masonry pier. At this point the rail is 180 feet above the water-level.

level beside a pier, and cranes the neck to look through the maze of steel rising overhead, that a graphic impression of its loftiness and solid character is secured.

There was one tragic episode connected with the erection of this labyrinth of metal which is brought forcibly to mind as one descends into the valley by the high road. There is a little knoll on one side, and from its crest a single shaft points its head towards the sky. The story of its origin is short but sad. The erection of the piers was in progress, and the men were busily driving the piles forming the foundation of those down by the water-side. The Battle River was in flood, and was tearing along at a furious pace. While the gang was driving the ponderous timbers into the ground something broke. Before the men could realise what had happened they were in the grip of the turbulent waters fighting frantically for their lives. One of the engineering staff engaged on the task, a young Englishman, grasping the serious plight of those in the water, without a moment's thought jumped into the torrent to lend assistance. He was able to get one or two to the bank, where willing hands hauled them to safety ; but when he gripped a third man, a Ruthenian, he was seen to sink. Precisely what happened will never be known. Either he was dragged down and suffocated by the frenzied non-swimmer, or else he was knocked senseless by a piece of debris. But both disappeared together with a Scotsman. Every effort was made to extend assistance from the bank, but without avail, owing to the fury of the river. It was only after a long and tedious search that the men working on the bridge retrieved the bodies of two of their comrades—the waters refused to deliver the corpse of the third man—and they were interred on the little knoll, while the monument, fashioned from material of which the great viaduct was constructed, commemorates their memory. Yet the little grave with the lonely pillar carrying their names, dates of birth and death, bathed in the shadow cast by the bridge,

brings home to the visitor the price of conquering the prairie with steel.

Strangely enough, it is when the prairie is almost crossed that the highest bridge on this section is found. The Pembina River disputed the railway's path at a place known as Entwistle—an end-of-steel town—66 miles west of Edmonton. The channel is practically a gorge of great depth, with steeply sloping sides. To cross from brink to brink a steelwork structure 900 feet in length became necessary. A pier in the waterway was found to be impracticable, so two main steel towers, one on either bank at the water's edge, were erected, and upon this the support for the track was erected, bringing the rails about 213 feet above the river. Despite its proportions, this bridge was erected in an amazingly short time, the setting of the steel occupying about two months.

An interesting illustration of the rigours of the Canadian Prohibition Liquor Law was provided during the building of this bridge. The latter was not taken in hand until the track itself had reached Wolf Creek, 54 miles beyond. An enterprising pioneer trekked to Entwistle, and impressed with the prospect of its developing into a healthy, permanent town, owing to coal having been found within easy distance, embarked upon what was to him a weighty undertaking—the provision of a hotel. It appeared to be a promising investment, as numbers of people were flocking to the spot. Edmonton was the nearest town where he could procure the requisite materials, and he had to transport them by road to Entwistle, an overland journey of nearly 80 miles, as the track was not laid. Undeterred by this outlook he attacked the enterprise, and after he had expended $22,000, or £4400, found himself possessed of a commodious, substantial building, with the prospect of flourishing business. He stocked his cellar with alcoholic liquors to the value of $8000, or £1600, and was anticipating the extension of the necessary licence without delay. But

PREPARING ONE SHORE END OF THE CLOVER BAR BRIDGE

Elaborate works are always requisite in the preparation of the shore supports of a western Canadian prairie railway bridge. The foundations have to be carried down to a great depth, owing to the friable nature of the soil.

to his dismay, instead of receiving official permission to vend liquor, the myrmidons of the law, in the form of the Mounted Police, arrived and sealed up the whole of his stock. He had overlooked the fact that the Pembina Bridge had not been built, the railway contractors having resorted to a temporary measure to negotiate the waterway. The authorities foresaw the formation of a big camp of bridge-builders, and that these worthies, like their colleagues on the grade, would indulge freely if the opportunity were given.

By a curious coincidence the commencement of the mountain division was marked by the construction of large bridge across the MacLeod River. This is a heavy piece of work, 667 feet long by 118 feet high. A small island in the centre of the main channel was pressed into service to carry a heavy concrete pier to form the central support to the two main spans. This bridge was completed likewise in a very short time, the setting of the steelwork occupying less than three months.

It might be thought that the mountains would impose a severe tax upon the bridge engineer, but such is not the case upon this railway. At Prairie Creek, at the entrance to the mountains, a structure 800 feet long had to be introduced to span the huge couloir in the flank of the foot-hills through which Prairie Creek, a mere stream, makes its way, while the crossing of the Athabaska River at Swift's Ranch called for a long and lofty structure, owing to the river being about 700 feet wide at this point. The Miette River likewise has to be crossed, in order to gain the summit in the Yellowhead Pass, but this is an insignificant piece of bridge-building, as is also the crossing of the Moose River, just below the falls of the same name.

Upon the conclusion of the survey it was feared that the Fraser River, owing to its tortuous course between towering cliffs, would call for considerable skill on the part of the bridge engineer, owing to the difficulty of securing

approaches except at great expense. The original location indicated the necessity of swinging from one side to the other of the " Bad River " no less than five times, but revision demonstrated the feasibility of reducing such effort to three occasions. The most notable of these is that whereby Fort George is entered. The selection of the site for this work occasioned considerable trouble, as the Nechaco enters the Fraser at this point, the meeting of the waters forming an extensive lake-like expanse. One problem was to find a good foundation for the intermediate piers, and though the river-bottom was probed carefully foot by foot, it appeared impossible to overcome this obstacle, unless heavy foundation work were undertaken, for the bed was found to be highly treacherous. At last, however, a number of islands scattered about the estuary were investigated, and here it was found possible to secure the desired end with complete satisfaction, so that now these waste patches of low-lying land are being pressed into service.

It was on the Pacific Coast that the Grand Trunk Pacific Railway was brought face to face with its greatest obstacle in connection with bridge-work, and this was before the line had passed 10 miles from Prince Rupert. This port stands on Kaien Island, separated from the mainland at the point where the railway crosses by the Zanardi Rapids. This is a constricted channel through which the water rushes at a furious pace with the movements of the tides, this velocity varying from 12 to 14 miles an hour, the alternating rise and fall of the ocean at this point during the highest tides being about 26 feet.

Though the channel is not very wide, it has called for the erection of a bridge nearly 1000 feet in length, including two spans of 55 feet each, two of 150 feet, and two of 250 feet. The last-named are the main or central spans, and it was the preparation of the piers for these that troubled the engineers.

THE LOFTIEST BRIDGE EAST OF THE ROCKY MOUNTAINS

The Pembina River has cut a deep wide channel through the soft friable soil. To span this gorge a bridge 900 feet long and 213 feet high in the centre was required. In the river is shown a log-boom, and the incline used by the contractors to transport materials across the waterway for the continuation of the grade while the bridge was being erected.

The racing of the waters was found to be so furious at the highest spring tides that divers could not descend, and consequently work had to be carried out in short periods between the ebb and flow when the water was at its lowest and quietest. This represented a total available working-time of three hours out of the twenty-four hours, and even then work was very difficult and perilous. Of course, during the neap tides the duration of working was proportionately longer. Cribs, or box-like structures, were built around the foundation-sites to provide a working space within, but it was found impossible at times to render them capable of withstanding the force of the water. The engineers thereupon steadied the cribs in position by a pair of massive cables stretching from two corners of the temporary work to either bank. This was partially successful, but one day their complacency with this manœuvre was disturbed very sadly by the wire hawsers snapping like pack-thread under the strain imposed by the pressure of the tides. As may be imagined, such capricious behaviour on the part of the sea was regarded by the workmen somewhat with alarm, and they kept a watchful eye and ear open ready to make their escape at the first signs of danger. Many thrilling moments were experienced, but owing to the unremitting vigilance and skill of the engineers no fatalities were incurred.

When it was found that two leashes were insufficient to hold the crib in check, two additional hawsers were pressed into service, a pair stretching to either bank both above and below the bridge site respectively. This served to hold the crib in position from each corner, and though the hawsers sung and groaned ominously, they held out until one day the whole four gave way under the strain, and the crib went rushing down-stream, the sport of the angry tidal water. It was a continuous uphill struggle against heavy odds, but science at last prevailed, and now a handsome, solidly built bridge carries the line across the Zanardi Rapids.

Higher up the Skeena, about 16 miles below Hazelton, where the railway sweeps across the waterway to gain the southern bank of the river, another spirited grapple with Nature has been waged in the erection of the largest bridge on the mountain division. When I was on the grade in the autumn of last year, the contractors were completing their arrangements for this undertaking. Directly the Skeena dropped to its lowest level, about October, the foundation work was to be commenced, and was to be continued without intermission throughout the winter, so that when the ice broke and the river, fed by the melting snows on the mountains, rose to its highest level in June, the workmen would be well above flood level, and could continue the erection of the piers to the level of the steelwork in safety. A vessel had been chartered specially to bring a whole cargo of cement from Hong Kong, and 5000 barrels had been hurried up the river, together with timber and other material likely to be demanded, and deposited upon the site. Everything had been gauged to a nicety, so that the workmen could carry out their task in accordance with a carefully prepared schedule like a train operating on a time-table.

But alas ! The best-laid schemes were torn awry sadly. Though the river-bed had been surveyed thoroughly and carefully, when it came to commencing the subaqueous work the unexpected was encountered in very truth. The bottom, instead of showing solidity, as soundings indicated, was composed of rotten rock, incapable of providing a suitable foundation. The specifications called for piers 120 feet in height from the bottom of the river to the level where the steelwork was to be placed into position, but when the true state of affairs was ascertained, it was realised that the foundations would have to be carried down to a far greater level than was anticipated. This upset calculations so seriously that, strive as they might, the contractors could not make up leeway—the handicap was too heavy.

The Skeena Bridge will be an imposing structure. The link of steel stretching from bank to bank is to be 1200 feet long, divided into two main spans and two shore spans, while the piers supporting the centre spans over the river channel will be 30 feet thick at the foundations. Solidity and weight in this connection have been imperative, owing to the velocity of the Skeena when in flood, and the huge amount of flotsam and jetsam in the form of uprooted trees which it brings down in its fury.

CHAPTER XXIV

ESTABLISHING A NEW PORT ON THE PACIFIC

FOR some time the one great stumbling-block to the completion of this new railway across the Dominion was the question of the outlet on the Pacific coast. Canada has but one Occidental gateway—Vancouver—and this fact sank so deeply into the minds of the people that they believed firmly and implicitly that there was no other point on that broken coastline where a port could be established. Yet Vancouver has only made its advance by force of circumstances. Though its anchorage is above reproach once the land-locked area of water is gained, yet navigators will tell one that it is the most dangerous port on the surface of the globe to enter. The entrance is a narrow strait, "The Narrows," and here the tide rushes through with great velocity. A speed of eight miles an hour is by no means uncommon, and skilful navigation is demanded to cope with this serious menace. Occasionally the significance of this peril is brought home forcibly by a ship being caught in the turmoil of current unawares and being smashed to pieces on the rock-girt coast. Owing to the proportions of the shipping industry, slow speed when navigating this attenuated neck of water is imperative, and this often proves the navigator's undoing, as he fails to secure steering-way. I came down the coast with one captain who but a few weeks before had entered this port for the first time in his life, though he knew all the other harbours of the world, from Vera Cruz to Singapore, and Sydney to Southampton. His boat could make

14 knots an hour, and he was leaving Vancouver under easy steam with the tide against him. When he reached The Narrows he found that the current was running at eight knots per hour, which was more than his vessel could steam at the moment, so he had to back into the bay to make another attempt!

When the Grand Trunk Pacific Railway was launched speculation was rife as to where they would establish their sea terminal at Vancouver, for it was thought absolutely impossible to be able to discover another suitable point on the Pacific sea-board. That hope had long been abandoned after fruitless expeditions. However, the authorities decided to carry out a minute investigation of the heavily indented coast-line to satisfy themselves as to whether or no a promising site for a second port had not been overlooked. A vessel was engaged for this curious mission, and, armed with Admiralty charts, a most thorough exploration was made along the coast between the United States and the Alaskan frontiers. No inlet was overlooked, and a voluminous report concerning the advantages and defects of each bay was prepared.

There was one known point which possessed sufficient attractions to become a sea-coast commercial centre. This was Port Simpson, at the extreme northern end of the Canadian Pacific coast-line, at the estuary of the loch forming the Portland Canal. Thirty years ago the question was debated as to whether Port Simpson or Vancouver should be developed, and choice ultimately fell upon the last-named. For years past coastal trading vessels plying between the south and Alaskan ports have called here regularly, while the Hudson's Bay maintain an important post, and practically speaking constitute the length and breadth of the port. There is a magnificent land-locked bay and ample anchorage for all classes of vessels. From the popular point of view it has one heavy drawback—it is the wettest spot on the coast, even

rivalling Vancouver in this respect, for the annual rainfall averages 120 inches per year!

The first investigations, however, were not fruitful. Exploration testified to the fact that although the coast-line is broken up more heavily than the Norwegian shore—which picturesque corner of the world it closely resembles and strongly recalls, with the majestic cliffs and beautiful fjords—the bays were of no practical value from an important trans-continental railway's point of view. Under the circumstances it appeared as if the enterprise would have to rest its western terminal upon the Pacific either at Port Simpson or Vancouver—there was nothing between these two extremities of the coast.

But in the course of the investigations the interest of the party engaged in this work had been aroused in a curious manner. They had examined the estuary of the Skeena River without success, and following the coast-line northwards had lighted upon a large bay known then as "Tuck's Inlet." Sheltered behind the hills was a huge sheet of water hemmed in on every side, and the general appearance conveyed the impression that this was the ideal locality for which they were searching. But at first they did not penetrate the inlet. Reference to the Admiralty chart showed the existence of a formidable obstruction stretching across the entrance in the form of a submerged rock or shoal. This was sufficient to render the spot useless from the mercantile point of view, so they glided past the entrance and completed their journey about 20 miles to the north at Port Simpson.

When the results of their investigations were communicated to the President, Mr. Charles Melville Hays somehow was attracted by Tuck's Inlet. It appeared to exercise an irresistible magnetism. Further investigations were made. Indians and white people frequenting these northern waters were interrogated, but they confessed that although an obstruction might exist at the mouth

of the inlet they knew nothing about it, which perhaps was not surprising because their boats drew only a few inches of water. As a result a second journey was made to the Skeena Estuary and Tuck's Inlet was entered and traversed from end to end, a distance of 14 miles. Furthermore, the President visited the spot himself, and impressed with the possibilities and outlook, requested a thorough survey to be made at the entrance for the obstruction, so as to be able to estimate its significance. The survey boat sailed up and down the mouth of the inlet, proceeding well out to sea and well inland on either side, sounding carefully and continually, but they could find no trace of any rock. Either it had never existed or it had disappeared under a seismological movement; the entrance was as clear and as unobstructed as the approach to Southampton or New York. The matter remained a mystery until at last it was discovered that in the preparation of the Admiralty chart the rock had been placed in the wrong bay! In reality it belonged to another indent of the coast. The mistake in that chart which had been accepted blindly as evidence of the unsuitability of Tuck's Inlet as a port had arrested the development of Canada's Pacific sea-board for a quarter of a century. By accident a new harbour had been discovered, and the rectification of the hoary error is rapidly transforming the Dominion's western frontier, and producing a "magnet of the north."

It was decided there and then that the new railway should have its Pacific terminal in this bay. From that moment there ensued a great forward movement in Northern British Columbia. Hardy pioneers set out for the new hub of human endeavour that was to be established 550 miles from civilisation, and as rapidly as the land was cleared tents sprang up to house these indomitable frontier ambassadors of commerce and industry.

From the scenic point of view the situation possessed every attraction. The shore rises up in a succession of

steep, low, rolling hills, rising higher until they mingle with the lofty mountains forming the background, and of which Mount Hays is the dominating monarch. When the railway President first arrived not a sign of civilisation disturbed the peace of Nature. There was an Indian village, Metlakatla, where the Reverend Duncan established his diminutive kingdom in one corner of the bay, but the site which appealed to the President was several miles from this faint Christianising indication. The mountain-sides were covered with towering trees and dense undergrowth, reaching down to the water's edge, while the soil comprised two feet or more of muskeg, damp and cold, covering the solid rock.

To establish a town here certainly appeared unfavourable, but the President had penetrated more forbidding country in which to carry the railway, so was not deterred by the outlook. Axes could clear the trees, while dynamite could level the humps. Without waste of time, he determined the most suitable site for the " Terminal City," and Prince Rupert was born.

Some curiosity has been evinced as to how the port received its name. It was recognised that " Tuck's Inlet " was neither dignified nor impressive. To secure a name which should be somewhat more in consonance with the character of the railway which was being built to afford another link between the Pacific and the Atlantic, appeal was made to the public for a suggestion, with a prize of $250, or £50, as an incentive. Some 15,000 letters were received in response to the invitation. Investigation revealed two titles closely similar—Port Rupert and Prince Rupert respectively. The latter, advanced by a young lady of Winnipeg, appeared the most singularly appropriate, since it extended recognition, somewhat tardy it is true, to the memory of one who had played an important part in unravelling the unknown northern country and its marvellous resources. Consequently, from

that day Tuck's Inlet became known as Prince Rupert. Owing to the close similarity of the two suggestions, however, the second contestant's effort received appreciation in the form of a cheque for a sum equal to the prize offered.

No time was lost in clearing the site for the town-builders, and in this direction an interesting anecdote is related. The President, upon surveying the aspect of trees, asked a contractor among the company, and who was experienced in the work of clearing, what would be his price to carry out the task. The contractor instantly expressed his willingness to fulfil the work at $200, or £40, per acre.

"What?" ejaculated the President somewhat incredulously.

"Well, I could do it safely for $300—£60—per acre," retorted the contractor.

"Look here," laughed the President. "I'm afraid you'll burn your fingers at that price. I'm prepared to pay you $400 (£80) per acre!"

The contractor opened his eyes widely, and came to the conclusion that he had better make a closer investigation before tendering for the work unless he wanted to court financial loss.

As a matter of fact, the initial clearing operation proved heartbreaking, for the forest was in its primeval condition. As the timber ran to a good size for the most part, the railway company established saw-mills on the spot, and the trees, as felled, were converted into lumber, for which there was a great demand for a thousand and one purposes. The first task to enable the railway construction to be commenced was to erect a small wharf to facilitate the unloading of incoming vessels with constructional material. When this was accomplished a large corps of surveyors appeared on the scene and prepared to lay out the town site.

The planning of Prince Rupert has indicated a new era

in regard to such work so far as Canada is concerned. Though the port is destined from its strategically powerful commercial situation to assume a prominent position on the Pacific coast, and, moreover, will develop into a thriving industrial and railway centre, it has been plotted on the latest and most scientific town-planning principles. The task was entrusted to a firm of landscape architects in Boston (U.S.A.), and the Garden City idea has been adopted on probably the largest scale yet attempted.

Owing to the extensive length of the water front, enabling vessels to berth lengthwise with ease, it is doubtful whether the lateral projecting wharfs, so characteristic of other American ports, will come into vogue, certainly not for many years to come, as their construction will entail an enormous expenditure, owing to the great depth of water, and the intensely hard rock forming the sea-bed. If such have to be attempted they will have to be wrought in masonry. The port will thus be spared one phase of disfigurement. The streets also rise in the form of terraces to the highest point, and fall away gradually in the same manner on the opposite hill-side. This topographical feature is being preserved and improved. The streets for the most part have been laid out at right angles to the water-side in such a way that the commercial centres of the town have direct communication with the latter. The thoroughfares, notwithstanding the hilly character of the town, have been provided with easy grades, and are of great width. This principle has been adopted to reduce the spreading effects of fire.

Owing to the surface being solid rock, which is encountered about two feet below the surface of the top-soil, which is merely decayed vegetable matter, town-improvement undertakings are proving extremely costly. Trenches for sewers and other purposes have to be excavated out of the solid rock. Again, owing to the undulating nature of

the hill-slopes, street-grading is laborious and expensive, inasmuch as the depressions which have to be filled in places are considerable. Despite these handicaps, however, the town has forged ahead with a rapidity almost without parallel in Canada, where towns spring up and grow like mushrooms. Within less than two years after its official foundation 5000 people had made the port their home, and they are controlled by one of the most enlightened, enterprising, albeit business-like civic governments in the world. Every member of the municipality is a hard-headed commercial man who has climbed the ladder of success from humble beginnings, and who, therefore, can be relied upon to secure full value for every penny expended, and to reduce waste to the minimum. This end is being achieved without hampering private enterprise in the slightest degree, and the result is a striking example of ratepayers and their representatives working hand-in-hand to secure the best results for the benefit of the whole community, both of to-day and to-morrow, without saddling posterity with millstones in the form of commitments to the fruits of short-sighted policies.

Though the town is dependent to a very great degree upon the railway, other enterprises are being attracted to contribute to the port's prosperity. Already it has become the centre of the Skeena Salmon Fishery, which now has ousted the Fraser River from premier importance. Canneries are to be found on all sides, there being twelve of these manufactories on the Skeena alone, employing 1200 boats and 2400 men during the season, when $100,000, or £20,000, a month is paid out in wages, while the annual export of produce to the United States and Great Britain exceeds 140,000 cases. The Skeena River salmon has proved more popular with the public, for the fish caught in these colder waters is plumper, firmer, more juicy and fleshy than that obtained farther south. This industry is almost entirely in the hands of the Indians and Orientals,

who have established themselves firmly on this part of the coast. This yield from the waters is supplemented by the halibut and herring catches. Within a few miles of the port the finest halibut in the world is obtained in abundance, this ground being to the Pacific what the Dogger Bank is to the North Sea, only it is within easier distance of the mainland.

The halibut fishery, however, is still in its infancy so far as Prince Rupert is concerned, for there is only one packing plant devoted to the preparation of this fish for the London market. Though the catch aggregates several million pounds per annum, the greater bulk is taken to Vancouver at present. This condition of affairs is to be changed when the railway is in communication with the interior parts of the Dominion, for the two days' journey by water down the coast will be obviated, and the markets in Eastern Canada brought that interval of time nearer the fishing-grounds. Large halibut-packing plants, financially supported by English and American capital, are already in course of construction at Prince Rupert.

The port also will become a great centre of the lumber industry, for enormous supplies of valuable timber are within easy reach. The pulp-wood industry should prove highly attractive also, for there are ample reserves of wood suited to this purpose immediately available. There is one large pulp-mill at Swanson's Bay, a little to the south of the port, but its development has been hampered by lack of convenient transport facilities.

Mining will certainly claim considerable attention, owing to the rich wealth of ore of all descriptions to be found in the surrounding mountains. A smelter has been projected, and should this scheme materialise it should afford first-class opportunities for the development of other metal industries. A small shipyard is in urgent request, and seeing that the shipping is increasing in volume very rapidly, it should prove a profitable investment.

But the future of Prince Rupert depends essentially upon its mercantile commerce. From the shipping point of view it possesses every possible attraction. In the first place there is no difficulty in making the port; its entrance faces the open Pacific, and is approachable in any kind of weather; and the task of entering the harbour is by no means a tax upon the navigator, seeing that it is three-quarters of a mile in width, extending out directly the portal is entered to $1\frac{1}{4}$ miles. Such natural facilities cannot be equalled by any other port on the Pacific coast. It is safer and easier to enter even than San Francisco. From the mouth the bay stretches in a continuous line for a length of 10 miles, with a maximum width of $1\frac{1}{2}$ miles, and there is sufficient depth of water to enable the largest vessels afloat to ride at anchor in absolute security, as the harbour is enclosed on all sides by towering mountains and hills. From the entrance the channel is straight and wide to the wharves. For night navigation automatic acetylene-lighted buoys have been installed. Indeed, a pilot is not necessary, as frequent experience has shown, captains who have never entered the port before threading the entrance and coming to within 50 feet of the wharves, and then only heaving-to in order to be brought alongside and moored.

Owing to the abrupt manner in which the mountains slope down into the water, considerable difficulty was experienced in erecting the timber wharf which at present suffices for the port's requirements, and which aggregates 1400 feet in length. Some of the piles utilised in its fabrication ran up to 110 feet in length by from 12 to 14 inches square. Alongside the wharf the depth of water ranges from 30 to 38 feet at lowest spring tides, while the extreme rise and fall of the tides is 26 feet. In the centre of the bay the depth of water is exceptional, ranging from 200 feet upwards. This is somewhat of a drawback in one respect, in that it hinders anchoring, but this state of

affairs is to be remedied by the installation of mooring buoys in the roadstead.

Considered from the shipping point of view Prince Rupert is certainly the Halifax of the Pacific, and it is somewhat curious that the new railway should link together the oldest and the youngest, as well as the finest two ports to be found in Canada, and situate on the two sea frontiers respectively. The fact that it is free from ice, a result due to the influence of the warm Japanese chinook wind, rendering it available the whole year round, is an appreciable factor in its favour. That its future as a shipping centre is realised to the full is borne out by the rapid increase in its maritime trade. Whereas in 1907 the tonnage handled did not exceed 700 tons per annum, by the end of the year 1910 it had risen to over 10,000 tons. When the railway is completed, and the port is brought into touch with Eastern and Central Canada, its oversea trade will increase with startling rapidity, since at the present moment the outgoing produce is strictly limited.

The railway company, together with the Government, has appropriated practically the whole of the water-front, thereby making adequate provision for the exigencies of the future, and avoiding lack of elbow-room when expansion sets in. An imposing terminus for the convenience of passengers is to be erected, as befitting a trans-continental railway, on the water-front, within a stone's-throw of the water's edge, so that the distance between railway and ship will be reduced to the minimum. Ample facilities are also to be provided for the expeditious handling of freight in accordance with modern methods. The station will be overlooked by a magnificent hotel, in accordance with the latest enterprise of the railway, which has found its first highly favourable expressions in the magnificent hostelries the "Château Laurier" at Ottawa, and the Selkirk Hotel at Winnipeg. Thus the requirements of travellers are being studied to a complete degree, so that

the tedium and anxiety of travel may be reduced to the minimum. For the purposes of these improvements the whole of the area within a certain distance of the front has been levelled by the aid of dynamite, and remembering the character of the site, and its rugged, hilly character, this has proved no easy achievement. When the first tree was felled there was not a level square foot of ground along the water-front, now there is something like 20,000 superficial feet of land as level as a bowling-green. Fourteen hard, solid months were expended in clearing and levelling the site whereon the present temporary buildings now stand, and dynamite was used with a liberal hand. In one blast a whole hill 100 feet in height was blown literally into the sea. This work is still in progress, since, in addition to the area required for the passenger service, miles of sidings will be in demand for the freight traffic.

The railway dominates the whole position. The property belonging to the Grand Trunk Pacific stretches over about 24,000 acres all told, so that there is ample provision for the future. In addition to the water frontage along Kaien Island the railway has secured also that immediately across the water, which, according to those already in residence, will develop into the residential quarter of the port. In all the railway owns 55 miles of water-front. This will solve the wharfage question when the mercantile traffic assumes such proportions as to demand more space. At the same time it secures virtual control of the port. Rivals will experience considerable difficulty in gaining access to the water and thus set up a competition which in the case of railways is often disastrous to both rivals.

One concealed nook of the bay offers a strange contrast to the bustling twentieth century with all its varied and intricate civilising influences. Here one may see the aboriginal where primitiveness, mythology, and quaint traditions still prevail. This is the Indian village of Metlakatla, and the juxtaposition of the two centres,

strangely divergent, appears incongruous. Metlakatla, with its weird, grotesque Indian monuments and bizarre cemetery, will rank as an interesting sight to the busy port. There is a possibility, however, that the village will become modernised, and will blossom into a sylvan retreat for the merchant magnates of Prince Rupert desiring to get away from the turmoil of the city. It would be interesting to penetrate the Indian's mask of stoical indifference to ascertain his innermost thoughts concerning the wonderful transformation that has been wrought over his country, for the land on which Prince Rupert is now rising up was part of the Indian reservation, and had to be purchased from the red men scarcely a decade ago.

CHAPTER XXV

THE FUTURE OF THE RAILWAY AND ITS INFLUENCE UPON CANADIAN AND INTERNATIONAL COMMERCE

WHEN the last coin for construction has been paid, when the cast-up account shows that some $100,000,000, or £20,000,000, have been sunk in the task of providing a new road of steel across the Dominion of Canada, the questions arise: What are the future prospects of this gigantic enterprise? How will it fare against the bitter competition that is certain to be waged by its powerful rivals? Can it pay?

In the first place it may be said that the new railway has nothing to fear from competition. It is like the army secure in an impregnable fortress, resisting an assault delivered over open country where the besiegers are exposed on all sides. Firmly entrenched as this railway is behind its low grades, it has nothing to fear from rate-wars. This physical advantage is too overwhelming to be overcome by such methods. Also, as traffic, like water, electricity, or any other movement of Nature, is certain to follow the path of least resistance, the stream of commerce flowing along the channel of the Grand Trunk Pacific will be safe from deflection; on the other hand, it will swell in volume. It is not difficult to realise that this latest enterprise, in the furtherance of which Canadian and British interests, both private and Governmental, have co-operated, is destined to dominate the railway situation in the Dominion, and without any of those adverse factors invariably associated with an autocratic power, because the

requirements of the people will always exercise a restraining influence through its representatives.

So far as the question of being commercially profitable under such progressive and enterprising control as guides the destinies of the line at present, there should be no forebodings. There is scarcely 100 miles of country threaded by the railway which is not possible of economic development in some form or other, and certainly to a more than adequate degree to render every mile of track revenue-producing. Even in the Maritime Provinces, where settlement has been advanced to such a pronounced extent, it traverses country awaiting the arrival of the husbandman. It seems difficult to believe that there are stretches of Nova Scotia and New Brunswick where evidences of civilisation are scarcely visible. One is apt to think that the most fertile areas were occupied years and years ago. Such is far from being the case. To-day the agriculturist is offered just as golden opportunities to excel among the valleys and dales of New Brunswick on either side of the Grand Trunk Pacific, and can secure land every whit as good as what was available half a century ago.

After leaving Moncton the railway has to follow a somewhat circuitous route through New Brunswick, in order to gain Quebec, owing to the State of Maine thrusting its boundary so far northwards towards the St. Lawrence River. Had it been possible to have cut across this intercepting territory, the mileage between the Atlantic seaboard and the river ports would have been reduced very materially, but the line was advocated as an "All-Red Route," and consequently it was forced to make a huge bend to skirt the political obstruction.

As already explained, when it crosses the St. Lawrence it strikes north-westwards towards the 55th parallel of latitude, passing through absolutely virgin country for about 1300 miles, where lumber, minerals, and land adapted admirably for diversified farming exist in abundance.

With the exception of 200 miles between Lake Nipigon and the edge of the prairie, every mile is capable of being brought to a highly productive stage. West of Winnipeg a vast treasure-house of grain is threaded for a solid 1000 miles. It is estimated that there are between 200,000,000 and 300,000,000 acres of land suited to cereal-raising on this great plain rolling away from Ontario's boundary to the Rocky Mountains. Seeing that the Canadian Pacific Railway draws a large proportion of its revenue from traffic created from about 7,000,000 acres—but a mere fraction of the aggregate—it will be recognised that the Grand Trunk Pacific holds a strong position so far as the Prairie Provinces are concerned.

Then there intervenes a stretch of about 170 miles, which, lying among the mountains, will be dependent mainly, for several years to come at all events, for an income from tourist traffic. Yet this in itself should attain considerable proportions, owing to the diversity of wonderful scenic beauty revealed among the Rockies at this point, with Mount Robson as the great magnet from the fact that it is the highest mountain in the Canadian Rockies. Unlimited opportunities are open to the mountaineer to display his climbing powers, not only on this peak, but on scores of other crests in the immediate vicinity, the majority of which rear up to a height of over 10,000 feet, and all awaiting the footstep of man on their higher levels. The sportsman, too, will revel here, for whether his quest is for fish, fur, or feather, he will be able to gratify his desires to the full among the dense forests and broad, swirling rivers. The neighbourhood has the material for development into a popular hydropathic spa, inasmuch as within easy reach of the line the hottest medicinal springs yet known in the Dominion have been discovered, and their therapeutic value is enhanced by their romantic situation, revealing magnificent panoramas of forest, mountains, lake, and river.

Emerging from the Rockies, the railway enters another wonderful agricultural belt, which ranks among the finest in the country. Here mixed farming holds out excellent inducements, while mining and lumbering have indicated their supreme importance. This country fringes the railway in an unbroken line for some 440 miles, to be broken abruptly by the uprising of the crests of the Cascades. This is Nature's own garden. There is no demand upon man to exercise his ingenuity in the devising of irrigation works which are costly, and which, after all, are but inefficient substitutes for natural watering. This country is broken up well by waterways, the benefits of which are completed by heavy dews and welcome summer showers, which meet amply the needs of the crops for refreshment during the dry season. But the fact must be borne in mind that clearing must not be carried to excess in the laudable effort to rescue the soil from its present frigidity. If denudation is carried to an extreme degree there, the same situation as now prevails in the United States will be precipitated. The hill-slopes, suited only to grazing, should be permitted to retain the timber growth, only the brush being cleared, for the purpose of conserving the rainfall. If indiscriminate deforestation be practised, then irrigation in New British Columbia will become as incumbent as it is in Southern Alberta and the United States to-day, and that within comparatively few years. Fortunately the authorities are alive to this contingency, and are maintaining a vigilant guard over the timber wealth.

So far as the Skeena River is concerned traffic will accrue from three principal sources—mining, fruit-raising, and sight-seeing. The exploited mining belt in Southern British Columbia is showing signs of becoming exhausted, and the men who were responsible for the creation of this industry on the " Boundary " are changing the fields of their labour there for the more promising land to the north. Between the massive flanks of the mountain walls are little valleys

sheltered from the destructive winds, where fruit-culture holds out extremely attractive possibilities. The tourist searching for Nature unadorned will find the jagged cliffs of the Cascades rising precipitously from the winding river to offer endless fascination. Large numbers of travellers will make the combined rail and river journey of 100 miles from Prince Rupert to Kitselas Canyon to admire this magnificent spectacle of mountain and waterfall in just the same way as they penetrate the Grand Canyon of Arizona, or ascend the mountain railways of Switzerland.

However, the influences exercised by this new steel highway will be felt far beyond the confines of the Dominion. In the first place, Alaska is striding forward with wonderful rapidity. Its growth to-day is as phenomenal as was that of Canada itself in the closing years of the nineteenth century. Its incalculable mineral wealth is being opened up, the railway conquest of the country has begun in decided earnest, and in the interior agriculture holds out every promise of attaining considerable proportions. The Alaskan summer lasts one hundred days, and in that brief season wheat and hay of the finest quality can be raised prolifically, and will find a ready market on the spot, as mining settlements spring up on all sides.

Already the traffic between the United States and its northern territory has swollen to large dimensions, and the tendency is being maintained. The southernmost limit of the Alaskan shore is only 30 miles distant from Prince Rupert, which is half-way between Seattle and Skaguay. The completion of the Grand Trunk Pacific Railway will bring that country about forty-eight hours nearer Chicago, New York, and the east, for the 550 miles' sail down the coast from Prince Rupert to Vancouver will be devoted to its equivalent time of travel across the continent by rail. In other words, a passenger bound for Chicago who lands at Prince Rupert to travel overland by the Grand Trunk

Pacific will have reached Edmonton by the time another passenger bound for the same city via the Canadian Pacific line lands at Vancouver. Such an advantage is too powerful to be ignored by commercial interests, and it is for this reason that the Eastern United States, which at present are suffering acutely from remote situation in regard to Alaska, are anticipating so keenly the driving of the "Golden Spike," signifying the completion of the new line, as it will constitute the highway to Alaska from their point of view.

Then again, it is destined to change travel around the Northern Hemisphere completely, because Prince Rupert, the western terminus, holds a peculiar position geographically. It is nearer Japan and China than any other port along the Pacific coast by about 500 miles. With the type of mail-boat at present in service on the Western Ocean, this represents a saving of about one day's steaming at least. Consequently, in these busy times, when no effort is spared to reduce the time occupied in travel, this line must develop into a great artery of traffic for merchandise, mail, and passengers flowing to and from Great Britain and the Orient via North America. The eastern centres of the United States have not failed to grasp the significance of this important factor, and it will be over the new transcontinental railway that the bulk of American traffic with Asia will pass from all points east of Chicago. As matters stand at the present moment the new line offers a means of reducing the time occupied in journeying between London or New York to Yokohama, Shanghai, and Hong Kong by twenty-four hours at the very least.

Rival ports on the Pacific may strive to nullify this handicap, but it is beyond their capacity. They can reduce, but they cannot eliminate the advantage presented to the railway by Nature. Faster boats may be pressed into service between Vancouver, Seattle, or San Francisco and the Asiatic sea-board, but the

rival favoured with geographical situation will merely have to adopt similar expedients to maintain its overwhelming lead.

This point has been driven home time after time, and has influenced the marvellous growth of Prince Rupert to a very emphatic degree. But now one can get beyond the bounds of theory ; possibility has been emphasised by the irrefutable evidence of practical results. A Vancouver freight-boat was commissioned to bring a cargo of cement from Hong Kong to Prince Rupert. According to the captain's own admissions, he made the new Canadian port three days earlier than he could have gained Vancouver. With modern high-speed mail-vessels such a great difference in time would not be feasible, but it would be proportionate. When mails are in transit, all things being equal, the quickest route is followed, and this will be the mail route to Asia. The Canadian Government and people will foster this development to their utmost, owing to their individual interest from the financial point of view. The creation of a large volume of remunerative traffic by native effort is certain, for the country has sunk the money in building 1800 miles of the line, and has assisted the second moiety very heavily. This combination of private and public enterprise is somewhat unusual, but it is a policy which in this particular instance augurs well for complete success.

The time thus saved in crossing the Pacific will be maintained, if not increased, on the journey across the continent, owing to the very easy grades through the mountains. A tangible idea of what this means in competition can be obtained very easily, and without soaring into the realms of fancy, by means of the existing time-tables. As the mountain grades of the Grand Trunk Pacific are no heavier than those found on the prairie, the schedule now in force between Winnipeg and Edmonton may be used for the whole journey, while the present trans-continental service

of the Canadian Pacific Railway affords a basis for comparison.

The Grand Trunk Pacific Winnipeg Express takes twenty-nine and a quarter hours to cover the 793 miles between the capitals of Manitoba and Alberta. This represents an average speed, including stops, of 27·1 miles per hour. On the same showing the journey of 949 miles between Edmonton and Prince Rupert should occupy a further thirty-five and a half hours, making sixty-four and three-quarter hours for the whole 1742 miles between the Pacific terminus and Winnipeg. The Canadian Pacific Railway requires sixty-four hours to cover the distance between Vancouver and Winnipeg, though its route is 258 miles shorter, but the average speed drops down to 23·18 miles per hour. This comparatively slow travelling is attributable entirely to the heavy adverse grades which have to be overcome in the mountains, and which nullify the advantage of less mileage.

But on a trans-continental journey such as this an accelerated schedule would be brought into force on the Grand Trunk Pacific as obtains on other similar systems for through traffic. Owing to the excellence of this permanent way, " The Limited " should be able to maintain a speed of 35 miles an hour easily. In this event Winnipeg would be only fifty hours distant from the coast, and the saving in travelling time by this route as compared with its rival would be no less than fourteen hours.

Moreover, while the Grand Trunk Pacific Railway can accelerate its service within very wide limits, the Canadian Pacific, on the other hand, is hampered by its grades to such an extent that acceleration on the existing road is well-nigh impossible. Re-alignment and reconstruction may possibly enable this handicap to be reduced somewhat, but it is doubtful, in view of the prodigious cost that would be involved, whether the end would justify the means.

The fact is only too palpable, when the Grand Trunk Pacific Railway settles down to trans-continental business, that Winnipeg will be brought between ten and fourteen hours nearer the Pacific coast than it is to-day. This is not idle conjecture, because the journey between Winnipeg and Edmonton has been completed with ease in twenty-four hours, representing an average speed of 33 miles per hour, and there is no cogent reason why this speed should not be maintained for another 949 miles to Prince Rupert.

Continuing eastwards from Winnipeg to Quebec, which is the mail port on the St. Lawrence River, the Grand Trunk Pacific increases its advantage very appreciably. In the first place, the distance is 236 miles less than the Canadian Pacific route between these two points, the respective distances being 1351 and 1587 miles. According to the time-table the Canadian Pacific Express occupies thirty-three and a quarter hours to cover this distance, which is equivalent to a speed of 28·42 miles per hour. Now as the Grand Trunk Pacific possesses no sharper curves and heavier grades east than are to be found west of Winnipeg, the Winnipeg-Edmonton train schedule may be used over this 1351 miles.

On this reckoning Quebec could be reached from the grain centre of the Dominion in less than fifty hours, showing a saving of time as compared with its rival of five and a half hours. But the saving would be much greater in practice. The Canadian Pacific Railway, after passing Winnipeg, accelerates its expresses by 5·24 miles per hour. The Grand Trunk Pacific, on the other hand, could accelerate to 35 miles per hour without undue effort, in which case the journey could be covered in 39·6 hours, giving a total saving in time on the journey of sixteen hours between Winnipeg and Quebec.

By travelling over the Grand Trunk Pacific between Quebec and Prince Rupert it will be possible to span the

Dominion in about ninety hours, whereas the journey to-day between Quebec and Vancouver occupies over 119 hours. Such an economy in time in favour of the former route, added to the time saved on the trans-Pacific Ocean journey, brings Quebec over two days nearer China and Japan, and the effect of this is radiated so far as New York on the one hand, and to London on the other.

If the journey is continued right through to the Atlantic sea-board a similar proportion results, for the rival railway cannot make up the time it loses in the toil through the mountains. On the other hand, the Grand Trunk Pacific is a galloping ground for the iron horse for the whole of its 3543 miles. Lest it may be thought that this new track will never be able to sustain high speeds, it may be mentioned that specials have whirled over short sections of the Winnipeg-Edmonton division at speeds ranging up to 60 miles an hour, and, as I can testify from experience, there is no greater oscillation or vibration when speeding along at that velocity than when travelling at 20 miles an hour. This offers convincing testimony to the excellence of the permanent way and its substantial construction.

There is another feature which must not be overlooked, and yet it is one of vital importance to the farmers on the prairie. Owing to the easy grades of the new line being so favourable to heavy trains, engines of equal capacity should be able to handle almost twice the tonnage on the Grand Trunk Pacific Railway as is possible on the Canadian Pacific Railway. In other words, if a certain engine could haul a train of 1000 tons on the latter line, the same engine should be able to draw 2000 tons over the new transcontinental track.

Now a vast quantity of grain is carried from the wheatlands of the west to the ports of the east by a combined rail and water route, which is cheaper than by through rail. It is this trade which, according to Mr. Duncan MacPherson,

M.INST.C.E., is in danger of being threatened with competition to such an extent as to make it appear " as if the days of the absolute supremacy of water transportation were in danger of, at least, a partial eclipse." *

" Transportation of grain by water has always been much cheaper than by rail, but the latter has been slowly but surely cheapening, until the present time, where the easy gradients and tremendously powerful locomotives of modern lines will make a combination on land difficult to excel or, peradventure, to equal, on water.

" The heaviest locomotive built to date (1909)—a Mallet articulated compound—is capable of hauling on this grade (21·12 feet per mile) a gross load behind the tender of 4290 tons. Assuming the tare 33½ per cent of the gross load, the net paying load would be 2860 tons, equal to 95,333 bushels of wheat, in one train. If we assume the earnings of such trains to be $4·40 (18s. 4d.) per train mile, or exactly double the earnings of the Canadian Pacific Railway freight train miles for 1908, we find the cost per bushel over the 1351 miles between Winnipeg and Quebec to be $4·25 (17s. 8d.). The lowest rate that the writer is aware of having been in force from Fort William to Montreal, via the Lake Canal and St. Lawrence River, a distance of 1216 miles, was 4 cents (2d.) per bushel for 1216 miles in 1908. This 4 cents per bushel would be equivalent to 4·44 cents 2·22d.) for 1351 miles, so that at $4·40 (18s. 4d.) per train mile, the engines above referred to could haul grain on the trans-continental railway east-bound from Winnipeg to Quebec for 0·19 cent (0·095d.) per bushel cheaper than the cheapest existing water route could haul it the same distance, and 10·86 cents (5·43d.) per bushel cheaper than the present combined rail and water rates between the two points in question. In brief, at about one-quarter the present rail and water rate."

* Paper read before the engineering section of the British Association at Winnipeg.

The advantage that the Grand Trunk Pacific Railway holds over its formidable rival between Winnipeg and Prince Rupert is far greater on the second half of the journey. In the former case it is easy grades alone which stand so much in its favour, but in the latter case it is both grades and shorter mileage which demand consideration. The distance between Winnipeg and Moncton, according to the above authority, is 261 miles less than the shortest distance over any other combined railways connecting these two points.

Yet the whole of the grain grown on the prairie will not move towards Europe by way of the Atlantic seaports. When Mr. Hays announced some few years ago that the grain raised west of a certain meridian would be shipped to Europe by way of the Pacific coast he was laughed to scorn. The idea of sending wheat more than half-way round the globe to the European markets was regarded as a huge joke. The obvious channel to Europe was via the Atlantic, had been so since wheat was first cultivated on the prairie, and would remain so until the crack of doom, argued the wiseacres.

The farmers, however, regarded this extraordinary pronouncement on the part of the railway President in a different light. That there was some cogent reason prompting his remarks was very evident to them, inasmuch as Mr. Hays very seldom speaks. They investigated the subject closely. To them it was a question of far-reaching importance, as transportation is a vital problem. A long train-haul is always and unavoidably expensive. If, by sending the grain via the Pacific sea-board, they could save an infinitesimal fraction of a cent per bushel over what it cost to forward in another direction, then that insignificant economy in freightage charges on the individual bushel would amount to a goodly sum when several thousand bushels were concerned. As a result of their quiet thinking and requests for further enlightenment upon the subject,

they found that the Grand Trunk Pacific, by virtue of its easy mountain grades, would be able to quote a lower rate for shipping grain westward of a certain line of demarcation on the prairie to Prince Rupert than the cheapest combined rail and water route eastwards to the Atlantic. What at first sight had appeared such a great absurdity quickly became a stern reality, for within a very short time of the President's expression of opinion concerning the movement of grain, the first boat-load of wheat grown on the prairie left Vancouver bound for England via Cape Horn. Others soon followed, some favouring the homeward run through the Suez Canal. The water journey was terribly lengthy, but it was cheaper.

The presidential prophecy having been discovered to be commercially practicable, the farmers in the west grew somewhat aggressive. Instead of meekly accepting the railway's decision as to which route their grain should be dispatched to Europe, they insisted emphatically that it should be sent the way they demanded, so that their transportation expenditure might be reduced.

This sudden change in the flow of the river of wheat from the great north-west is certain to exercise a great influence upon the future of Prince Rupert. Certain interests have assailed the railway for establishing its Pacific port so far north, but as this opposition has proceeded from rival shipping centres along the coast, it has failed to produce any permanent impression. Then they have veered round, and stated that, although Prince Rupert is the nominal port, the new trans-continental railway intends to establish its Pacific head-quarters at Vancouver. Even to-day, despite official denials, this theory is maintained tenaciously in many quarters, it being pointed out that Prince Rupert can never be more than a mere trans-shipping centre—it fails to possess the opportunities for development such as exist at Vancouver, Seattle, or San Francisco. But, as a matter of fact, it has facilities for

economic development far greater than any of its Pacific rivals can show. Yet its growth will be at the expense of its southern rival on Canadian territory.

When the line is opened the movement of wheat via the Pacific to Europe will reflect its tremendous proportions at Prince Rupert. Huge grain elevators have been planned, and are to be erected on the water-front to house the grain pending shipment. The port will be to the west in regard to grain what Fort William will be to the Great Lakes and the east—the wheat-clearing centre. This traffic will assume its greatest proportions when the Panama Canal is completed, for a shorter route between Western Canada and this country by water will be available.

The traffic that will be created in the vicinity of Prince Rupert alone will be of such a character as to bring very appreciable revenue to the railway. The port's future as a great maritime centre is assured, and, moreover, it will become the Grimsby of the Pacific. Within 100 miles of the port are the largest fishing-grounds in the New World. A huge sum of money is sunk in this harvest of the sea, and the whole of the traffic is handled at present at Vancouver and Seattle, whence it is transported by rail to the eastern provinces of Canada and the United States, as well as this country. In a recent year over 50,000,000 pounds of halibut alone were taken from these adjacent beds. In weight this represented the equivalent of 50,000 head of beef. This was taken south, and 90 per cent of this produce was dispatched by the various railways to the Atlantic sea-board, a considerable quantity reaching Great Britain. The sail from the Pacific banks to Vancouver occupied from three to four days. When the Grand Trunk Pacific is completed, this long transport to railway terminals will be avoided, and the hauls will be sent through the new channel, so that the various markets where this fish is held in high esteem will receive it from two to four days earlier

than is possible at present, this saving of time representing an equivalent period of freshness.

It is difficult to realise the future of this fishing industry around Prince Rupert. In a single catch over 400,000 pounds of edible fish, comprising nearly thirty varieties, have been secured in eight hours. There is an available market of some 100,000,000 people for this produce, and by the new railway and its various spurs connecting with other lines on the great North American Continent the fishing-grounds will be brought into direct communication with the table. The salmon fishery alone has attained considerable dimensions, although yet it is only in its infancy. The average yearly export of this commodity caught in the Skeena and Naas Rivers approximates $1,000,000, or £200,000, and this is capable of considerable extension when immediate railway facilities are provided.

The discovery of gold and other commercial minerals at Stewart will affect this new port and railway to an appreciable extent, seeing that it is the only supply point for the district. Stewart is less than 100 miles north of Prince Rupert, and as the country opens up a new and valuable source of traffic tributary to the railway will be created.

The construction of this new highway across the Dominion, however, does not constitute the Alpha and Omega of this huge enterprise. The Grand Trunk Pacific will be to Canada what the Cape to Cairo line will become to Africa—the railway backbone of the country, with spurs radiating on either side tapping valuable areas to feed the main stream. On the prairie, south of the main track, a network of lines is being woven, extending to competitive points, contemporaneously with the growth of the vertebra. A policy of spirited aggression is being followed with no respect for any rival's preserves. One outcome of this movement will be an alternative outlet to Vancouver, in conjunction with the magnificent railroads controlled by

Mr. James J. Hill. The Grand Trunk Pacific will throw its tentacle through the Crow's-nest Pass to link up with the latter system, gaining access to Spokane, Vancouver, Southern British Columbia, Seattle, and San Francisco. Calgary is being brought into touch with the main system, while Regina, the progressive capital of Saskatchewan, is being provided with a link from Melville, and will be connected with the American railways as well as with Hudson's Bay.

In due course the Klondyke will be connected with the rest of the continent, providing an all-rail route between the United States and Alaska. In the east charters have been secured for the construction of alternative lines traversing unexploited sections of Ontario and Quebec, affording shorter and quicker communication between the Grand Trunk Pacific and its parent system, the Grand Trunk Railway. The construction of these spurs will be prosecuted as the country develops, but it is in the great west that the greatest railway-building activity and initiative is being manifested to-day. Still, it is a significant sign of the reawakening of the east that pressure is being exercised from all sides to bring the main line into touch with a number of adjacent and highly promising districts where development has commenced.

By the time the Government's years of grace, enabling the railway to create its traffic, and to establish its footing firmly on the ladder of prosperity, have expired, the system should have secured a position of unassailable independency. If the present state of affairs is maintained—there is every indication that a set-back in Canada's economic expansion is remote in the extreme—and the country along the new railway continues to be settled as rapidly and as thoroughly as is the case to-day, then those who have supported the enterprise will gain a rich reward. The work has been prosecuted with remarkable vigour, and, bearing in mind the innumerable and prodigious diffi-

culties that have had to be overcome, undoubtedly it ranks as one of the greatest achievements of modern times. Certainly it is one of the most stupendous undertakings that a young country of less than 7,000,000 people ever attempted.

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DR. LEO FROBENIUS

TRANSLATED BY

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